for . . .

engineers and contractors controlling the design, specification, installation and maintenance of heating, ventilating and air conditioning.

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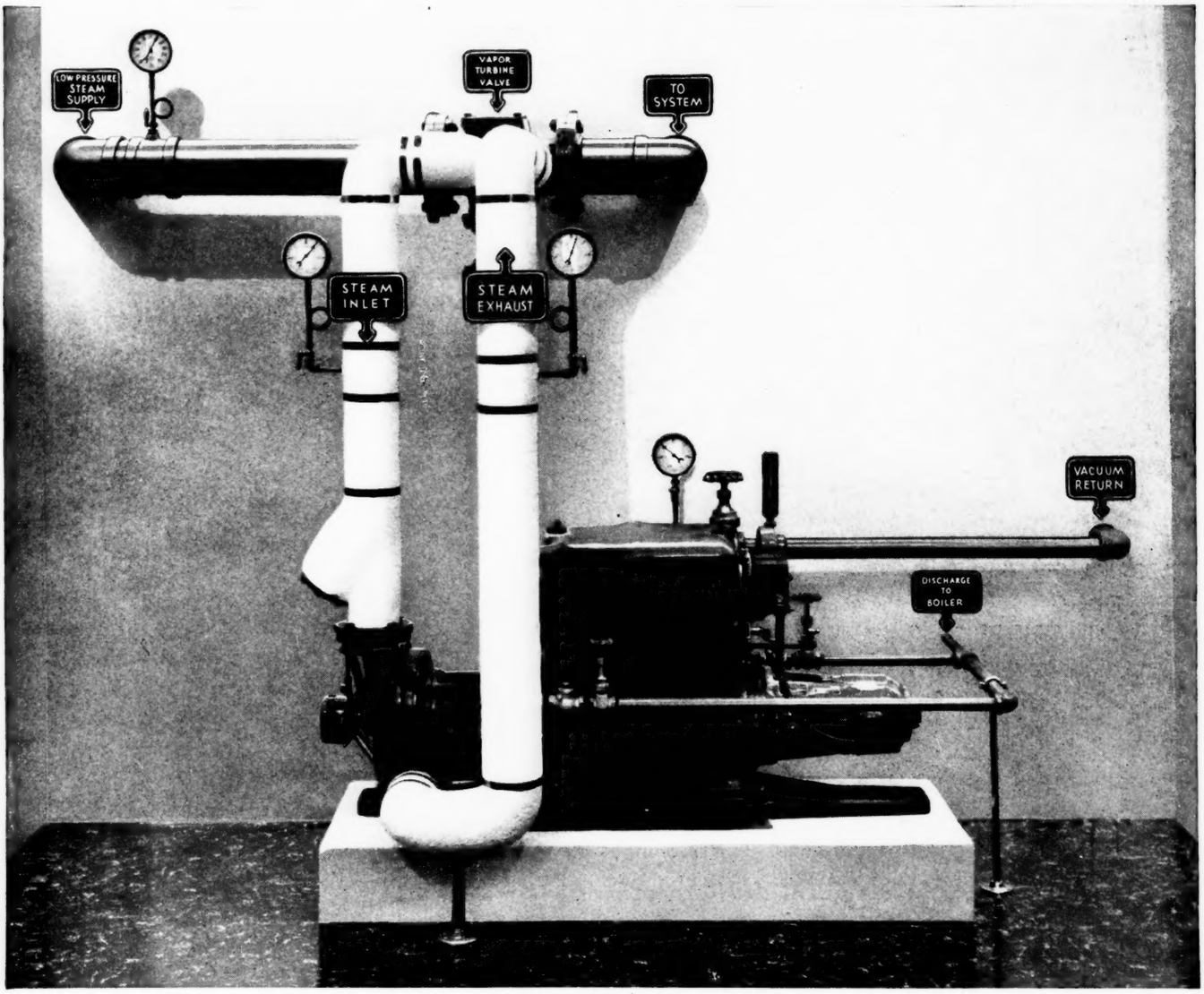
Where Heat Must Not Fail— Install this SAFE Heating Pump!



In Hospitals, Greenhouses, Schools, Public Buildings, Theatres, wherever heating systems must not fail, install the Nash Vapor Turbine, for it is independent of electric current failure, and continues to operate as long as there is steam in the system.

This is because the prime motive power of this economical pump is a special steam turbine, controlled by a unique "Vapor Turbine Valve", which automatically bypasses from the heating main a small portion of steam, the exact amount necessary to develop the power needed to remove the condensate and maintain the required vacuum on the system. Even this small amount is passed immediately back to the mains, and goes on to the system with little heat loss. This pump operates on any system, high or low pressure.

The Vapor Turbine is a most economical pump, for the elimination of electric current does away with current cost, the largest single item in the operation of an ordinary return line heating pump. Bulletin on request.

THE NASH ENGINEERING COMPANY

205-A S. WILSON ROAD, SOUTH NORWALK, CONNECTICUT, U. S. A.

The I-B-R Research Home.

Radiator Research House Dedicated; Tentative Progress Report Made

WITH representatives of the heating industry from all parts of the United States in attendance, the I-B-R Research Home at the University of Illinois was dedicated May 23. Sponsored by the Institute of Boiler and Radiator Manufacturers, the Research Home was described at the dedication as the most completely equipped research house in the world for the study of heating.

Dean M. L. Enger, College of Engineering, University of Illinois, presided at a luncheon meeting. Speakers included Dr. A. C. Willard, president of the University of Illinois, and R. E. Ferry, general manager of the Institute of Boiler and Radiator Manufacturers.

Progress reports on the I-B-R Research Home were made by A. P. Kratz, research professor of mechanical engineering; W. S. Harris, special research associate in mechanical engineering; and R. J. Martin, special research assistant in mechanical engineering.

Among the outstanding facts already developed by this investigation are that the cost for heating this six room house for an entire average heating season in Champaign will be approximately only $69; that temperature variation can be held to less than one degree; and that a negligible temperature difference occurs between air temperature in the house and the inside surface of the wall, even at severe temperatures.

President Willard declared that the University of Illinois has been interested in research in heating and ventilating for more than a quarter of a century.

"While the University carries on cooperative research work with many groups," said President Willard, "no industry has given us more whole-hearted cooperation than the heating and ventilating industry.

"I have every confidence that these constructive relationships will continue for many years in the future."

In introducing President Willard, Dean Enger said that 25% of all expenditures for research work by land grant colleges are made by the University of Illinois, and that it also issues more technical and scientific bulletins than any other university.

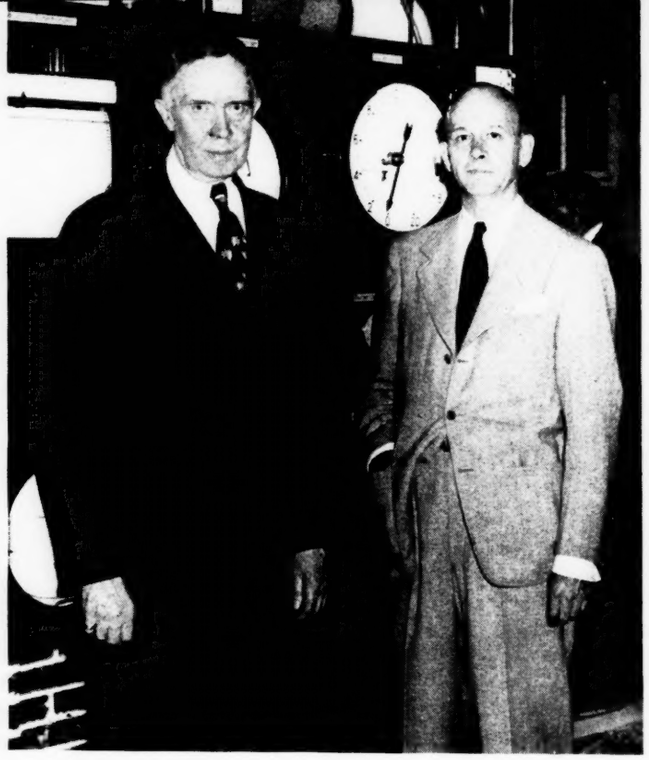
Mr. Ferry said that the long-term objectives of the I-B-R Research Program are the economic and technical improvement of steam and hot water heating. At the morning session Mr. Ferry spoke on "New Developments in Steam and Water Heating Systems." After reviewing historical development leading up to the small tube radiator of today, which has been "subdued in appearance but enhanced in efficiency", he prophesied continued progress as a result of the constructive measures being taken by I-B-R.

In January, 1940, thirteen manufacturers of cast iron boilers and radiators decided to build the most completely equipped laboratory house in the world for studying the efficiency of heating plants under actual operating conditions; also, the effect of various systems of heating on environment and comfort. The I-B-R Research Home, now being opened, is the result.

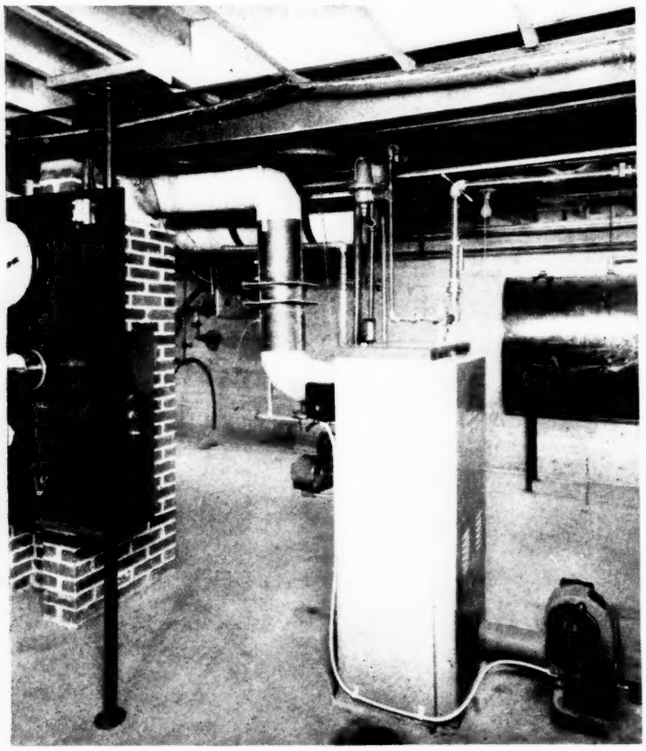
"The basic purpose of the research program," Mr. Ferry said, "is to develop extensive and accurate data on the how and the why of health and comfort in the home. The results of the research program will not only provide manufacturers with valuable information on the design of equipment but will also provide heating contractors and engineers with new facts, useful to them in design and sales promotion work.

"The I-B-R-Research Home is a typical six room brick veneer house in the medium price range. The

At the speakers table at the I-B-R Dinner. Left to right, L. N. Hunter, Vice-President and Director of Research, National Radiator Corp.; H. F. Moore, Research Professor of Engineering Materials, University of Illinois; R. E. Ferry, General Manager, Institute of Boiler and Radiator Manufacturers; M. L. Enger, Dean of the College of Engineering and Director of Engineering Experiment Station, University of Illinois; O. A. Leutwiller, Head, Mechanical Engineering Department, University of Illinois, and John P. Magos, Director of Research, Crane Co., and Chairman of Advisory Research Committee, Institute of Boiler and Radiator Manufacturers.



Dr. A. C. Willard, President of the University of Illinois and R. E. Ferry, Manager of the Institute of Boiler and Radiator Manufacturers, in front of the instrument panel in the basement of the Research Home.

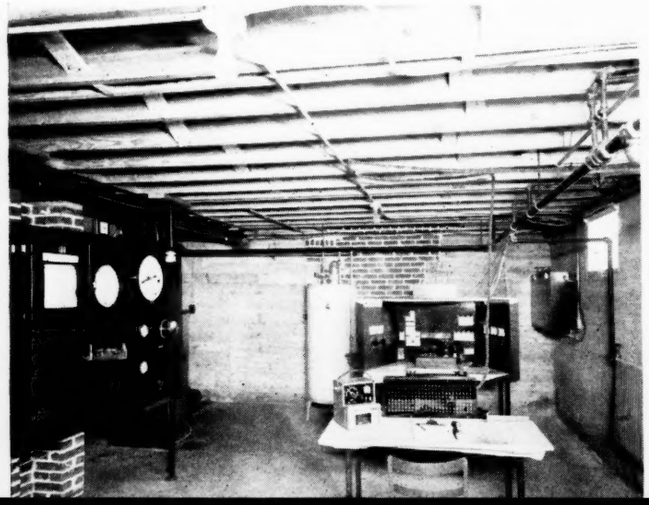


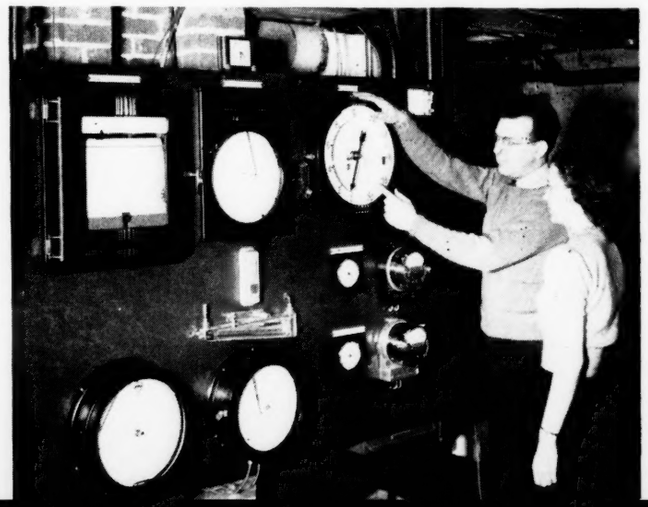
Closeup of the hot water boiler and oil burner used in the early tests at the Research Home.

Prof. A. P. Kratz pointing out one of the 205 thermocouples to a group in the living room of the Research Home.

View in the basement of the Research Home. Automatic recorders and draft gauge are shown at the left. Thermocouple readings are made at the larger table and moisture readings at the table in the foreground.

Research Assistant R. J. Martin explaining how recording potentiometers, flue gas recorders, CO_2 recorders and other instruments work in the I-B-R Research Home.





cubage of the main part of the house is 20,630 cu ft, with 9,700 cu ft to be heated on the first and second floors, and 6,020 cu ft in the basement.

"In the construction of the house, the I-B-R Advisory Research Committee recognized the fact that comfort and economy cannot be had simply by installing a heating system of excess capacity to care for deficiencies in the structure. Cold walls, drafts, and extreme temperature differentials between floor and ceiling and between floors result from poor construction. And they must be eliminated if satisfactory atmospheric conditions are to be realized.

"A thoroughly insulated house was therefore agreed upon as an essential of the Research Home," Mr. Ferry pointed out. "The walls were insulated with 3⅝ in. of mineral wool, protected on the inside with a vapor barrier of glazed asphalt paper. Rocklath was used as plaster base, and wood sheathing was used and covered with a 15 lb building paper.

"All windows are weather stripped. Storm windows have been purchased but initial tests which began with the opening of the house on January 1, 1941, are being run without them. The ceiling of the second floor is insulated with mineral wool, the same as the outside walls. The roof has wood sheathing and asphalt shingles.

"Over 80 moisture points are buried in various parts of the house to record moisture changes in various structural members," Mr. Ferry explained, "and over 100 thermocouples in the walls are giving a record of the efficiency of various types of construction, as well as comfort conditions within the house."

"Outside temperature and humidity, as well as wind direction, velocity, and hours of sunshine are recorded by a weather station.

"Inside the house, thermocouples are located in each room, and temperatures may be recorded at the master panel in the basement. The temperatures are taken in each room at the floor and ceiling levels, and at 30 and 60 in. from the floor.

"Another important instrument included in the equipment for studying environment condition in the home is a globe thermometer. This instrument is a black copper sphere that measures the mean gradiant temperature, the final factor in assuring 'comfort efficiency.' "

The Advisory Research Committee selected a one-pipe forced circulation hot water system, using an oil burning boiler, for the first series of tests. Among the factors influencing this decision were the increasing popularity of this type system. Four-column, 19-inch recessed radiators were selected because they fit nicely in a four-inch stud wall.

"Boiler efficiency is being carefully studied, as well as the effectiveness of the distribution and radiation system. Flow of water through the system, including each radiator, is being recorded. Temperature of water entering and leaving the boiler is also being noted," Mr. Ferry explained.

"While current tests at the I-B-R Research Home are on the one-pipe forced-circulation hot-water system, steam and vapor heating systems will also be included in the investigations as the test program is extended," he added.

He also told his listeners of the benefits that have resulted from the development of the I-B-R Testing and Rating Code for Low Pressure Heating Boilers. "Nearly all cast iron boilers for residences are now rated on a uniform basis, so that a common yard stick has been established for measuring capacities of boilers. And I-B-R Ratings represent a measure of performance which can be accepted with full confidence that the boiler will deliver the output which is published," Mr. Ferry stated.

Recognition of the value of this work was recently shown by the award of a certificate of honorable mention by a jury headed by Secretary of Commerce Jesse H. Jones. The I-B-R Rating program was selected as one of the seven outstanding achievements accomplished during 1940 out of more than 2000 national associations.

With this explanation of the objectives of the I-B-R, and its current activities, the guests proceeded to inspect the Research Home immediately after lunch. There, parties were shown through the house by the staff, and the test equipment and methods were explained.

In the evening, following the I-B-R Dinner, a technical program was presented. At this program Dr. H. F. Moore, Research Professor of Engineering Materials, University of Illinois, discussed cooperative research in technical schools.

He explained the advantages technical schools offer for cooperative research of the character being carried out with the I-B-R, and also explained that while the extensive facilities available at the University of Illinois made it practical to carry out such research advantageously and economically, the University does not wish, and is not equipped to carry out, routine testing in competition with commercial laboratories.

Professor Kratz briefly reviewed the origin of the I-B-R Research Home, so far as the University's interest in it was concerned, and paid special tribute to the staff that has carried out the test work for being able to obtain important results in the short time since the house was available for tests.

A brief resume of the details of the house was then given by R. J. Martin, Special Research Assistant in Mechanical Engineering. Heat loss was calculated at 43,371 Btu per hr for the house without storm sash, and 32,504 with storm sash. Calculations were based on data in the ASHVE Guide. The crackage method was used to determine infiltration losses, he explained. The boiler selected had a rating of 63,000 Btu, and a total of 166 sections of cast iron 19-inch 4-column radiators were installed.

In telling of the test results to date, W. S. Harris, special research associate in mechanical engineering, said they would fall in three classes of data: That affecting the house itself; atmospheric conditions within the house; and the operating characteristics of the system while these conditions were maintained.

Principal facts relating to the operating characteristics of the house, in so far as they affect the comfort in it, are that only a temperature difference of 2F occurs between room temperature and wall surface with an outside temperature of 13F. The thermocouples

showed a temperature drop of 45F in the rockwool, which proved the equivalent of 46 inches of brick.

Second was the findings with respect to radiator recess construction. With a temperature difference of 32F between inside and outside air, the average for Champaign, it was found that the loss through one foot of uninsulated recess, except for reflective surface behind radiator, was the equivalent of 6½ ft of standard insulated wall construction. In a recess where 25/32 in. insulation board was added, the loss was approximately equal to 3½ sq ft of the insulated wall.

A remarkably uniform temperature was found to exist throughout the house, Mr. Harris reported. A fluctuation of less than one degree was observed. During one period of observation, at the control, or 30 in., level maximum variation in temperature was 0.5F. At ceiling level the fluctuation reached 0.9F, and at the floor level 0.8F. So far as temperature difference at the different levels is concerned, it was found that with the boiler operating with the flow valve closed and a minimum boiler temperature of 160F, there was 1½F difference between the floor and 30-inch level, and 3F between the 30-inch level and the ceiling.

With regard to humidity conditions, it was not found necessary to introduce moisture during the period of operation. Measurements showed that with a 70F temperature difference between the inside and outside air, the relative humidity dropped to 20%. With a 15F difference, humidity reached 50%. While no humidity was introduced during the test period, it is realized, of course, Mr. Harris explained, that the house was new, and that some moisture may have been obtained from the drying out of plaster. More conclusive results will be obtained on this phase in later tests.

In checking attic temperatures against calculated temperatures it was found that they were somewhat higher than figured. In analyzing the reason for this Mr. Harris explained that it might be due to two factors: heat given off from the chimney (an inside chimney), and effect of sun on the roof.

Among results of studies of equipment, data were obtained on the comparative efficiency of the boiler operated strictly with forced circulation against forced circulation and gravity.

A comparison with a temperature difference of 32F shows that with the flow valve closed the burner operated 4 hours out of the 24 hour period. Energy requirements were 500 watt hours of power and 32 lb of fuel. The burner operated 15 cycles. With the flow valve open, allowing gravity circulation of the water when the circulation was not in operation, only 3 hours of burner operation were required, and energy consumption was cut to 330 watt hours of electricity and 26 lb of oil were used. There was no change in the number of cycles.

While the number of cycles of the burner and the circulator were the same, the circulator operated from 15 to 20 minutes longer than the burner.

Another interesting fact is that while the boiler was designed to required 24 hour operation of the burner at — 10F, results indicate that approximately 10 hours of operation would provide adequate heat for this extreme condition. The design called for 200F water with a temperature drop of 10F through the radiators.

It is also of importance to observe that no provision was made for heat introduced in the house during the testing. Among such sources are the occupants of the house and power equipment such as the burner motor and circulator motor. Studies indicate that this heat supply would be adequate to take care of a 5F temperature difference.

Cost data indicate there is a ratio of about 10 to 1 in the cost of fuel as compared to the cost of power. Here, again, comparisons were made with the flow valve closed and also with it open. With it closed, the oil cost was 33 cents for a 24 hour period; the power 2½ cents. With the flow valve open, the fuel cost was 27 cents and the power cost was 2½ cents. A rough figure for the total cost of heating the house is 1¼ cents per degree-day, and, from the half season during which the house has been operated, it is believed that the total cost to heat the house for one heating season in Champaign, at current fuel costs, would be $69. In discussion, it was stated that from data presented the cost for fuel to supply domestic hot water was about $20. The figure was not checked or confirmed. However, the fact was given that on mild days from 4 to 7 lb of oil were used to maintain the desired boiler water temperature, although in cold weather little difference in fuel cost was noted.

After the presentation of these results some lively discussion took place, and it was generally agreed that an extensive program of research would be required to solve all of the current problems.

An Example of Defense Building

The ability of the building industry to speed up vital defense construction work, despite winter deterrents, is being demonstrated at Farmingdale, L. I., N. Y., where the new factory of Republic Aviation Corporation, designed by Albert Kahn Associated Architects and Engineers, Inc., is being rushed to completion by the Turner Construction Company, general contractor.

This project includes a manufacturing and assembly building measuring 900 by 500 ft and covers more than ten acres of open floor space. The total cost of the new plant will represent an outlay of approximately $5,280,000.

The speed which has characterized construction is indicated by the steady progress made since January 3, when building was authorized. Excavation was in full swing on January 6; general excavation work was completed nine days later; foundations were substantially completed by February 15, and the 4000-ton structural steel framing was practically completed by April 1.

Heating and ventilating is provided by unit heaters. The building is provided with a sprinkler system, containing about 10,000 heads. The boiler house, adjacent to the building at the southwest corner, will contain two oil-fired boilers, and three 1500 cu. ft. compressors. Space is also provided in this building for the servicing, charging and storing of 15 electric trucks.

Theory Vs. Practice

By T. W. REYNOLDS

The Boiler Is Not Always to Blame

IT is not an infrequent occurrence to have some investigator declare a certain boiler too small for the load imposed on it and as proof of the statement an overall computation is submitted giving the total heat-losing area of the exterior walls, glass, and other surfaces of the house, together with an assumed hourly air change of one and a half for the gross cubage of the structure. Such figures may be all in full accord with standard practice and authoritative coefficients may have been used in their derivation, yet if the boiler raises pressure in a reasonable length of time with proper firing or proper adjustment of the burner, there is nothing wrong with the size of the boiler and nothing right with the standard figures.

Occasionally in trouble work a boiler will be condemned as inadequate in capacity, especially so where steam pressure is not raised in the customary time. Obviously, pressure is merely an indication that steam is being made faster than it is used, the excess supply building up as a reserve in the form of pressure. It is, of course, possible and practical to heat structures of small size quite satisfactorily without any noticeable indication of pressure, providing the piping is liberally sized so as to greatly minimize the amount of pressure drop.

Sometimes pressure can not be raised in boilers of certain types because of omissions or carelessness in the cementing of the spaces between boiler sections, thus causing the hot gases to short circuit or by-pass valuable heat absorbing surfaces on their way out. Boilers requiring cement between sections are quite apt to be short circuited through failure of the erector to read the instructions or take the necessary time to apply the cement. This cement should be applied as each section is assembled and not at some later time as usually done, if it is done at all. Once the boiler is fully assembled it becomes difficult to apply the cement in a thorough and permanent manner while movements of expansion and contraction and mechanical injury from contact with cleaning tools sooner or later dislodge the cement from between the sections.

Another cause of short circuit is wrong assembly of boiler sections. For example, an open uptake section which is normally installed next to the rear section may be installed through error near the front of the boiler, so that gases from the fuel bed rise through the open section and then pass directly through the upper flue gallery to the stack without seeing much of the boiler at all. Fortunately, with some boilers it is not possible to join the sections together except as intended by the designer and with all boilers the greatest of care has been taken by the manufacturers through erecting instructions printed in large type and by markings on each boiler section so as to preclude the making of such errors. In spite of all precautionary measures errors of this nature are made from time to time for the first thing the erector usually does is throw away the boiler instruction card as an insult to his intelligence.

Boilers are sometimes condemned for various other reasons. For example, a round boiler, if with only four sections, will no longer perform when converted from coal to oil burning. Manufacturers do not recommend four-section round boilers for use with oil fuel and all that can be done cheaply with an existing installation of this kind is to experiment on it with baffles in the hope of some betterment. Failing in this, the boiler must be replaced, except where it is practical to add a section.

Five-section round boilers are often replaced because they are mistaken for four-section boilers, especially where there is no substantial variation in diameter and height as between two different makes. It should be remembered, however, that boilers can be equal in physical dimensions, yet be unequal in capacity if one of these boilers has an additional gas passage to absorb more of the heat from the leaving gases.

The writer recalls one curious incident of a large sectional boiler which was condemned, not upon the basis of inadequate capacity, but upon the apparent crackage of three intermediate sections through lowered water line, for water was observed as it dripped between these sections. Service could not very well be interrupted by separating the sections for a more detailed examination; a contract was let and new sections ordered, only to find upon taking apart of the boiler for insertion of the new sections that nothing at all was cracked. What happened was that the boiler blew away its water as steam through the safety valve for some time and it was this water that made the boiler wet between the three sections. The safety valve had blown due to a combination of coincidental causes, such as an oversize boiler previously well fueled by an occasional attendant and an ash pit so shallow that accumulated ash at the rear prevented the ash pit draft door from fully closing.

Fig. 1. Three production lines in the Up-to-Date Candy Manufacturing Company's plant. Large duct near ceiling supplies dehumidified air at 78F to the room while small duct below supplies dehumidified air at 65F to the candy cooling belts.

CANDY MANUFACTURING PLANTS

find that independent dehumidification in their manufacturing rooms helps reduce losses and increases production particularly in warm weather.

By HARRY W. SMITH, JR.†

LESS than three years ago, one New England hard-candy producer installed in two of his packing and storing rooms independent dehumidification—air conditioning equipment designed to regulate moisture conditions within the plant separately from and independent of other air conditioning equipment intended primarily for cooling purposes. Insofar as is known, this was the first application in the confectionery field of gas-fired independent dehumidification. But it started a trend—it emphasized to many candy manufacturers new possibilities for production improvements by bringing air humidity as well as air temperature under the thumb of the plant superintendent—it revised many a candy man's viewpoint on air conditioning—and it provided a stimulus which, in three short years, has been responsible for at least 20 further adaptations of independent dehumidification by other candy-makers, and the results summarized here.

Today, it is possible to collect case-history data on dehumidification-air-conditioning, as applied to almost

†Director, Industrial Publicity, American Gas Association.

PROFITS IN AIR

NO. 45 OF A SERIES DEALING WITH ATMOSPHERIC CONDITIONS IN INDUSTRIAL PLANTS.

HOW INDUSTRIAL PLANTS PROMOTE PROCESSES AND PROFITS BY SCIENTIFIC CONTROL OF ATMOSPHERIC CONDITIONS

CANDY INDUSTRY

any step in candy manufacturing, from starch room to final packaging. Further, independent dehumidification is today serving all types of producers: the packaged-chocolates maker, the bulk hard candy manufacturer, the chocolate stock producer, the specialty confectioner, and the fancy goods specialist. Before considering the why, the how, and the results of typical installations, a general comment or two with regard to the possible deleterious effects of humidity in the candy field is in order.

Moisture in Candy-Making

In any manufacturing operation moisture can appear to cause trouble by its simple condensation from humid air onto relatively cooler surfaces. And many production troubles in candy manufacturing fall in this category. But where sugar is involved, particularly the invert sugars resulting from high-temperature cooking, moisture can appear to interfere with production operations by the very hygroscopic nature of sugar itself, even though conditions may not be favorable for pure mechanical moisture condensation. By this hygroscopic action, the invert sugars absorb moisture whenever the water vapor-pressure of the sugar is less than the water vapor-pressure of the surrounding atmosphere. The higher the temperature at which the sugar is cooked in candy-making, the higher the percentage of invert sugar in the goods and the greater is the tendency for a wet sticky surface to develop on candy exposed to unconditioned air. For example, it is not uncommon in caramel hardening rooms for the candy to accumulate as much as ¼ of an inch of semi-dissolved "goo" on the top surface during spring or fall weather of high dewpoint. Even if this hygroscopic action of invert sugars is not sufficient to spoil the batch, it may result in enough stickiness to clog production machinery, slow down production cycles, necessitate extra drying operations, or result in the development of sugar bloom on the goods.

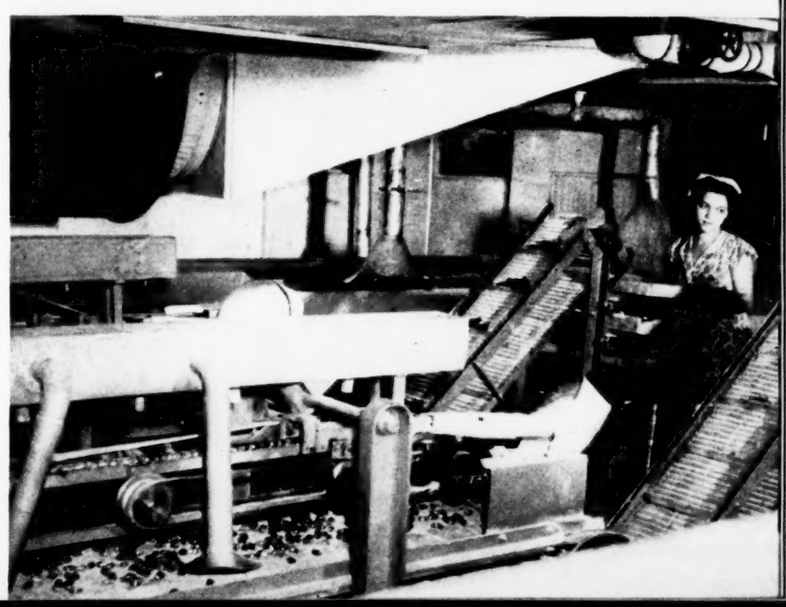
Sugar bloom, in contradistinction to "fat bloom" is the result of moisture, either absorbed by or condensed on the product. Sugar bloom is nothing but the crystallization of uncombined sugars on the surface of candy due to its solution by moisture and subsequent deposition when the moisture is evaporated away. Fat bloom on the other hand is a temperature problem—and is thought to result from an overheating (the result of careless processing control, adverse weather, or the effect of sunlight in the dealer's window) of the fat globules and their consequent decomposition.

Few industries stand to lose so much as the candy industry through the attacks of Old-Man-Humidity—(1) at every point along the line, from raw material to final consumption by the customer, and (2) because the very product itself has a chemical affinity for water. Hence, few industries have a bigger stake in independent dehumidification. It should be encouraging to candy manufacturers that ways have been found to control plant humidity irrespective of the amount of refrigeration air conditioning available—that the engineers in the plants here to be discussed have done so complete a pioneering job for the remainder of the industry to follow and improve.

Types of Dehumidification Equipment Available

As for the dehumidification equipment itself, several types are available today. Those units used in the installations here to be described are of the solid adsorption type, wherein silica gel or activated alumina desiccates air passing through it, and is subsequently *reactivated* for further use by being heated with hot air from an integral gas-fired unit. Thus, the solid adsorbent withdraws moisture from the air to be conditioned and later discharges it to heated air which goes up the flue with the products of combustion. Such units, made respectively by The Bryant Heater Company, Cleveland, and the Pittsburgh Lectrodryer Corporation, Pittsburgh, are available in a wide range of sizes, and may be either of the rotary-continuous or intermittent-tray type. Other types of independent dehumidification equipment, such as the Surface Combustion's Kathabar lithium-chloride liquid absorption unit, or calcium-chloride dryers are also in use.

Fig. 2. One of the cooling belts in the plant of the Up-to-Date Candy Manufacturing plant. At the left can be seen the cold air jets which supply dehumidified air at 65F to cool the candy.

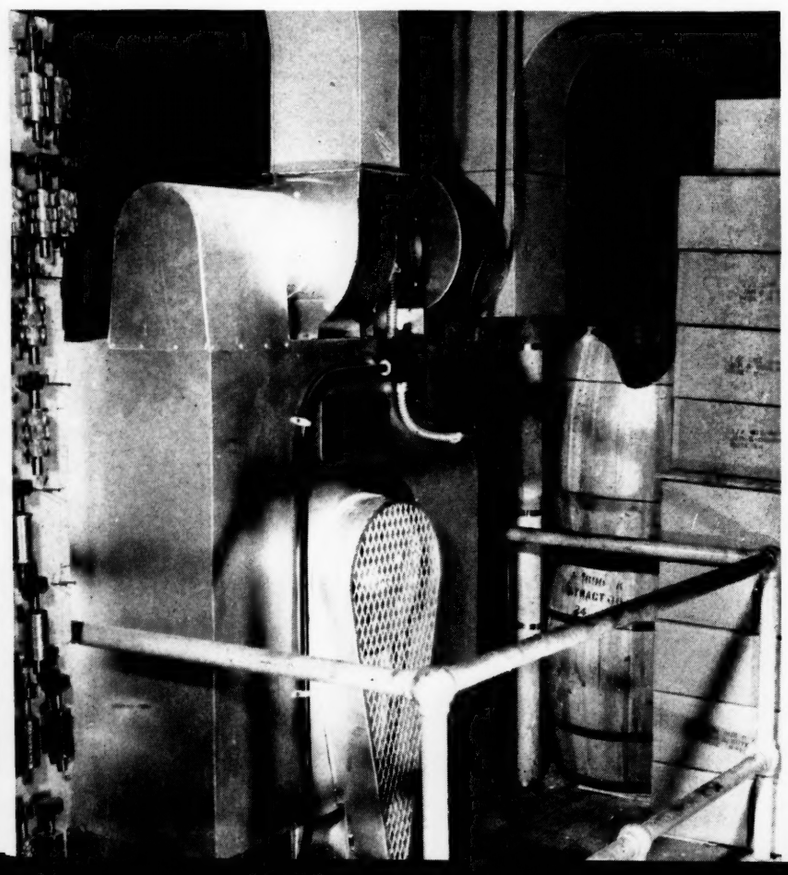


Applications

Rapidly growing is the list of candy manufacturers who are, for the first time, stressing the importance of humidity control in all departments of production. Mr. E. A. Sanstrom of Walter Baker and Company, Inc., leading producer of chocolate stock, expressed his opinion in the October, 1940, issue of *The Manufacturing Confectioner* in these words:

"Cooling alone is of considerable importance, but safe conditions are not obtained unless the humidity is also controlled. Under conditions of high humidity, even in a cool location, it is possible that condensation will be formed which, at the least, will cause formation of sugar crystals on the chocolate surfaces and, if the conditions of high humidity are of long duration, there may be danger of mould. In addition to these reasons for controlling both humidity and temperature, there is the fact that chocolate improves with a period of aging, in both working characteristics and flavor. This aging must take place under the best possible clean and sanitary atmospheric conditions."

Other newcomers to dehumidification include: The Ohio Confection Company of Cleveland; Miller and Hollis, Inc., of Boston (who dehumidify the make-up air to the 45F cooling tunnels surrounding the four exit belts from hand-dipping lines in order to prevent moist air infiltration and too rapid icing of the refrigerating coils); the Stark Candy Company of Milwaukee (which has reported a silica gel installation to facilitate caramel wrapping, and totally eliminate moisture condensation on wrapper or goods by maintaining a condition of 40% relative humidity irrespective of outside conditions); and the Goelitz Confectionery Company of Midland Park, New Jersey (who have also had experience with gas-fired dehumidification equipment in facilitating the manufacture of their specialty, candy corn). Below, to be described in greater detail, are dehumidification air conditioning installations which have solved major production problems for the following firms: the Up-to-Date Candy Manufacturing Company of New York City and the Stark Candy Co., of Milwaukee, Wis. Two other installations were described previously in HEATING AND VENTILATING—Edgar P. Lewis & Sons, Inc., of Malden, Mass., in August, 1940, and Durkee-Mower, Inc., of Lynn, Mass., in December, 1940. These companies have cooperated in supplying photographs, case history data and other information with regard to their expanding usage of independent dehumidification, and the writer takes this opportunity to thank these producers for their help.



Up-To-Date Candy Manufacturing Co.

At the Up-to-Date Candy Manufacturing Company, Bronx, New York City, gas-fired independent dehumidification has been adapted in an unusual manner to (1) the seven cooling belts from hard candy machines, (2) the hard candy sorting tables, and (3) the hard candy packaging operations—all in one large room, 45 ft x 35 ft x 11 ft high (see Fig. 1). During the September to December peak, this company produces 60,000 lb per day of hard candies, sold in bulk under the trade name of *Up-to-Date* and in fancy packages and jars under the name of Arden. The seven lines handle 3000 lb of goods per hr, which, on an annual average, represents one-half to one-third of the plant's production.

The most unusual feature of this installation is that the dry air delivered from the Lectrodryer (a continuous activated alumina dehumidification unit using heat to reactivate the desiccant) is delivered to the distribution duct at 28% relative humidity, and is subsequently cooled by cold water coils to 65F. This extreme degree of drying and cooling is effected so that part of the air may be conducted directly to the cooling belts and thrown down upon the candy at 65F, while the remainder is reheated to 78F by steam coils before being discharged into the room for the general space air conditioning. In Fig. 1, the narrow duct just below the larger main ducting at the top of the photo carries this extra-cold air (unreheated) to the distribution ducting which may be seen over the two cooling-belt lines visible in the background. Special cold-air jets (one is seen in close-up at the left of Fig. 2) are manifolded to the ducting over each cooling belt, and drop vertically down to direct the cold air through a fishtail nozzle within one or two inches of the traveling candy. At the right of Fig. 1 may be seen another extra-cold air discharge jet descending vertically to a cone-type nozzle

Fig. 3. Close-up of Pittsburgh Lectrodryer which is used for dehumidifying air in Up-to-Date Manufacturing plant. During heavy production periods when steam is available at 105 lb it is used to reactivate the dehumidifier. At other times, when steam is not available, city gas operates unit.

for the direction of extra-cold air over one sorting and screening table.

This over-cooling of the air and its subsequent reheating is feasible only because the manufacturer has on his property a 200-gallon-per-minute well delivering 56F water. After the reheating, the main quantity of air, supplying the room proper through narrow registers just below the ceiling level (two may be seen in Fig. 1), is discharged at a condition of 78F and 35-40% relative humidity. The large fan for distribution of this major quantity of conditioned air is powered by a 5 hp motor—the dehumidifier drive itself consuming only 10 hp. Further, part of the air at 35-40% relative humidity and 78F is recirculated through ten filters without again going through the dehumidifier. Thus, candy dust is removed.

The firing of the dehumidifier itself (Fig. 3) is both by steam and by gas. During heavy production shifts when steam at 105 lb is available for plant heating and process uses, steam supplies the heat necessary continuously to reactivate the activated alumina in the dehumidifier. At other times, when steam is not available, city gas is burned to operate the unit. Obviously, this candy cooling, sorting and storage room must be air conditioned 24 hours a day, so that moisture cannot creep in overnight and gum up the yet unpacked production of the previous shift.

As a result of the installation, A. Tehel, production manager, says: "The operations in this room have never been shut down since air conditioning was installed, whereas previously ten or fifteen days per year of interruptions were necessary during certain adverse weather periods. October and November were previously the dangerous months. Seldom were bad humidity conditions encountered in mid-summer. Further, the air conditioning has eliminated a great deal of sticking in the cooling belt machinery, and on the trays."

Finally, by packing its 35 lb hermetically-sealed tins of satin-finish goods in a dehumidified room, insurance against candy stickiness is permanently attained—through periods of shipment, storage and handling, right up to the point of opening in the retail store.

Up-to-Date has used two tons of refrigeration air conditioning in its carton-packaging room for many years—but recent experience with independent dehumidification in the operations above described has demonstrated the limitations of this installation where no separate control over humidity conditions is practicable. Although this refrigeration air conditioning machinery may be in full operation, and hence the carton-packaging-room temperature well under control, there are occasional humid days on which the packaging machinery will gum and stick. Experience in the separately dehumidified hard candy room has been entirely satisfactory in every particular, even on these days when carton-packaging-machine troubles were encountered in the refrigerated room.

Stark Candy Company

The Stark Candy Company of Milwaukee, Wis., was organized by Howard L. Stark to make caramels and lozenges. Mr. Stark knew from his long experience in the candy industry that the caramels presented an especially difficult problem due to the variations in temperature encountered in Milwaukee. Therefore he specified that a Bryant silica gel dehumidifying unit be installed to control the humidity in the caramel room. In this room an 80F temperature was maintained through a Bryant dry air cooler which is supplied with city water. The air conditioning system is operated during the working day of eight hours and an 80F temperature and 40% humidity are maintained. Not only does this facilitate the manufacture and the packing but also is desirable from the standpoint of preventing temperature change when the product is shipped to the outside. This prevents any condensation taking place on the caramel wrapper which may occur if the operation were performed in a room at a lower temperature. All waste water is piped to the roof to help reduce the heat load on the building. The dehumidifier used will handle 500 cfm per minute.

Fig. 4. A section of the hand dipping room in the Edgar P. Lewis plant. This room is supplied with dehumidified air by a Bryant silica gel unit. Air conditions of 63F and 50% relative humidity are maintained.

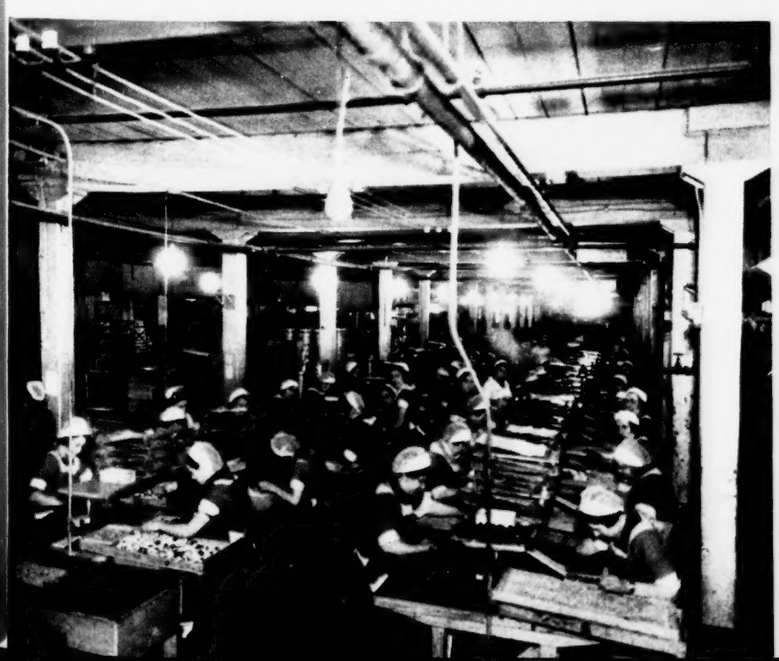


Fig. 5. A section of the enrober room in the Edgar P. Lewis plant. Room has a cubage of 130,000 ft and is occupied by 300 employes. Air is dehumidified by gas-fired Bryant dehumidifier.

PROFITS IN AIR

DUST CONTROL

system design, installation and operation from the common-sense standpoint is discussed in this article.

By F. F. KRAVATH†

WHILE the writer has, in the past, concerned himself with the technical aspects of dust control and air-flow in pipes and will probably return to preaching and, he hopes, teaching the correct way to work with air in this endeavor, he has in the course of his designing, plant, and consulting experience come across certain fundamentals of plant procedure which need a thorough airing. These fundamentals, simple though they all are, can, if abused, cause the management and operating personnel of a plant much trouble, expense, and chagrin and can do much to nullify an otherwise praiseworthy undertaking for plant dust control. If understood, appreciated for their true worth, and dealt with firmly and surely, these fundamentals enhance and safeguard the plant's dust control plan, as well as protect its name and investment.

First of all, we must fix it firmly in our minds that dust control is not something which we can buy quickly, easily, and painlessly from our favorite sheet metal contractor. Dust control is not merely an exhaust system which can be purchased, run until it is completely worn out, outmoded, or inadequate and then replaced with another exhaust system bought just as painlessly. Dust control is a living thing. It is a policy and a procedure devised and carefully checked by the plant's operating personnel, and instituted and enforced by the plant's management whereby clean, healthful, dust and fume-free atmospheric conditions are provided and maintained at all times within the plant. If, in order to secure such conditions, one or more exhaust systems are necessary, then it is to be remembered that these systems are only some of the tools necessary in order to achieve a full result. If respirators are necessary for certain operations, and there are many operations where they are fully justified, then again we must remember these are only tools, and as such should be kept in proper shape and used only where they are most applicable. Even a system of lung X-ray examinations is only a tool, but if used properly and in conjunction with the other necessary tools, it contributes its share toward real dust control.

†Office Engineering Division, The Panama Canal.

Design

In the design of production machinery every effort is exerted to secure the most efficient, the most trouble-free, and the most economical product. All three affecting profit, as they do, there is no skimping when it comes to design. Sufficient thought is concentrated on the problem to insure a satisfactory outcome, and since that objective is paramount, it is pursued until attained.

That is the attitude that should be taken when the broad objective of dust control is sought. Since the result is all-important, there should be no skimping on design, no sacrifice of thought, and certainly no disinterest on the part of the plant operating personnel. While there is usually little profit to be gained by the establishment of complete dust control measures within a plant, except, of course, where the quality of the product is bettered, where cleaner conditions result in increased production, or where the dust captured is salable, there is, on the other hand, plenty of evidence that it is costly to ignore dust control. Whether it is rapid wear of machinery, pressure exerted on the plant by the state department of health or labor, or a disastrous law suit or compensation award that finally prompts a plant to take measures in the direction of dust control, it is imperative that economies desired be not attained at the expense of design.

Many small plants with a limited engineering force are in no position to assign one of their staff to the dust control problem to the extent where the assignee becomes quite expert in the design of such control equipment, although where this is possible it is always recommended. Where the plant's own men are unable to furnish an adequate design, it is urged that a competent consultant be called in to furnish complete

HOW INDUSTRIAL PLANTS PROMOTE PROCESSES AND PROFITS BY SCIENTIFIC CONTROL OF ATMOSPHERIC CONDITIONS

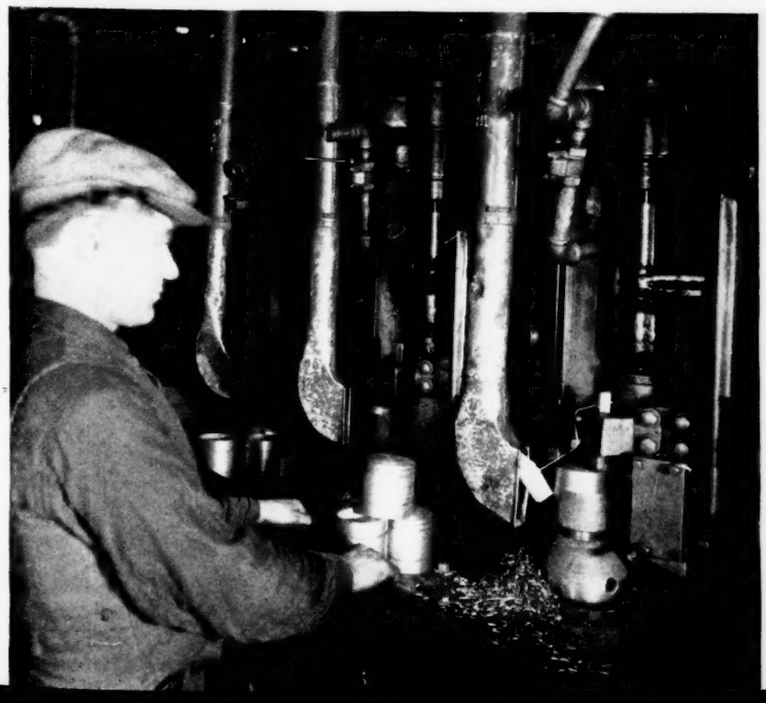
specifications and designs, after a thorough study is made of the various problems in company with one of the plant operating personnel. With the designs furnished, it is almost a foregone conclusion that keen, competitive bidding will wipe out all, if not exceed, the consultant's fee, without jeopardizing the quantity or quality of the material furnished—which is all set forth in the specifications. While most of the larger manufacturers of air handling equipment have competent engineers on their staff, and are fully capable of designing and installing a completely effective exhaust system, it must be understood that they are placed at a disadvantage when forced to bid against some small sheet metal contractor with no true conception of adequate dust control, with no burden of engineering talent, and very few scruples as regards the furnishing of fans, motors, drives, platforms, filters, piping, hoods, and supports, and still less interest in what happens a year or so after installation. It must not be assumed from this that all small contractors are without good design men, or that all large contractors will always furnish a scrupulously honest and perfectly performing installation. However, it should certainly be apparent that small and large, good and bad, they all stand on a more equal footing when bidding on completely drawn-up and specified designs.

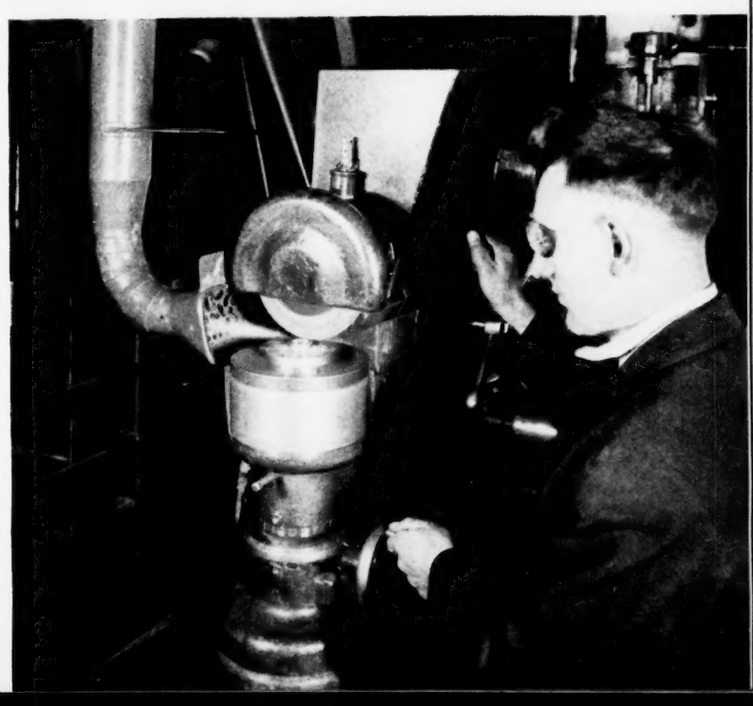
Hence, summing up, every effort should be exerted to secure as good a design as it is possible to attain. The problem should be studied thoroughly and with the help of trained assistance, if necessary, for in any event the total cost of design will in most cases be but a small fraction of the cost of installation.

PROFITS IN AIR

NO. 46 OF A SERIES DEALING WITH ATMOSPHERIC CONDITIONS IN INDUSTRIAL PLANTS.

COMMON-SENSE POLICIES IN DUST CONTROL





Use of Equipment Furnished

One of the most important problems facing the designer is to produce not only an effective design but one which is usable all the time. Dust control is not effective if it is operative only 75% or even 90% of the time. It must be operated as long as there is any need for it and not, as so often happens, only when readily permitted by the physical capabilities of the dust control equipment or by the productive machine and operation performed. Too often the argument is heard from production personnel in the plant that "while the hood works swell on most work, we have to take the thing off in order to do our special work." That is an admission of either inferior hood design, lack of willingness to co-operate on the part of the plant men, or disinterest in the whole dust control program. Interest and co-operation must be in evidence, as must be superior design in order to attain 100% dust control. Study of the operations performed on the production machine is essential if the designer is to develop a hood which while being effective interferes only negligibly with the machine operator. Co-operation must be in evidence between design and production personnel if the designer is to obtain a complete picture of all the operations performed, for this picture is indispensably necessary for the design of a hood which will be used all the time.

Falling into the same category are exhaust systems which must be stopped during working hours for such servicing as cloth filter shaking, inspection, frequent repairs, or cleaning out of pipes which have become loaded up with deposited material. Since most state laws decree a compulsory rest period for all workmen approximately every four or five hours, advantage could be taken of this break in the production schedule to shake filters and make inspections. If it is necessary that production machinery work steadily for eight or more hours, then the cloth area of the filter should be made large enough so that at the end of the operating period the exhaust system is still handling sufficient air for good control. Where production areas operate under 24 hour schedules, provisions should be made to shut the air off from one portion of the filter while it is being shaken, and to successively shake each section, but enough cloth area must be specified so that even during the shaking period sufficient air is induced to insure satisfactory room conditions. Inspections, where such schedules are in effect, should be made on week-ends. Superior design will preclude too rapid wear of piping, filters, etc., as it will forestall precipitation in piping.

When holes appear in the piping or some other part of the system begins to deteriorate or operate in an inferior way, repair should be immediate. Since this is a matter of health, it should take precedence over other repairs.

One of the really exasperating conditions found in industry is the dis-use of existing equipment. So often does it happen that foremen forget to start up one or more of their exhaust systems, that operators neglect to close a door or other safeguard on their hood, or open a butterfly valve which will cause air to enter the hood. Another case occurs where respirators are provided but not worn. It is needless to say that such actions are wrong. It is imperative that they be eliminated. If men refuse to conform, they should be replaced for the good of all concerned.

The writer does not wish to appear pedantic, but the importance of following this procedure cannot be overestimated. The writer has had occasion to appear as an expert witness at two hearings within the last half year based on dust diseases. Attendance at other hearings, as an interested spectator, and careful perusal of court proceedings of cases held throughout the country have definitely proved to him that not only is the plant held responsible, almost universally, for the failure or refusal of employees to use safeguards provided for them, in the event that such employees enter claim for disability at some future date, but the very men who offer the most resistance to conforming to the health regulations in effect are the ones who use the argument of company negligence in their fight.

Court cases and even compensation board hearings are not always the halls of justice they are supposed to be. In the heat of argument many statements are made which are prejudicial to one side or the other. Complete explanation of technical details, even if allowed, might result only in utter confusion of the jurors or referee, and thus gain little. Clever lawyers seize just such loopholes as are presented by hoods which are in operation only 75% of the time, or of piping habitually in a state of dis-repair, or of exhaust systems which are down daily for servicing during an operating period. They make a very dramatic, sarcastic presentation, exaggerating out of all importance the actual harmful effects that may or may not be produced. To top it off, they may request a visit to the scene of the *crime*, in this case the workshop. Imagine the effect on a jury, composed, perhaps, of some office workers, housewives, and small businessmen, when they walk through an extremely dusty room during a period of dust control equipment servicing. No amount of subsequent argument would erase that picture from their minds. Hence, it must be borne in mind that since a jury or state referee may be the ultimate judge of the efficiency of dust control within a plant, too much solace should not be taken in the fact that the petrographer's report indicated a presence of silica not exceeding 7.36%, that the dust count as taken with the Greenburg-Smith Impinger revealed a concentration of only 42,000,000 particles per cubic foot, average particle size lying between 10 and 15 microns (conceded to be too large to be very dangerous), and that various medical authorities have agreed that such conditions are relatively safe. There are always doctors to be gotten for the opposing side who will disagree with the consensus; there are always engineers to be had who will question the method of taking the count, or evaluating the result, so that enough confu-

sion will result in the minds of the jury or referee to make them or him grasp at something concrete like the worn-out pipes, inoperative hoods, or dusty room during servicing, to indicate a negligent attitude on the part of the company.

From experience, the writer has found that operations and departments which may look extremely dirty are often far less harmful than locations in which the dust or fume hazard cannot even be seen. Very often these *dirty* locations are flooded with sunlight which tends to exaggerate the presence of air pollutants. Also, a relatively low concentration of large granules, which might be altogether safe from a health standpoint, often appears far more deadly than a much greater concentration of extremely small dust particles. Thus, a jury or state inspector walking through such areas would in all probability get untrue pictures of the relative health hazards existent. Hence, the necessity for all areas not only being non-hazardous, but visually clean, is exceedingly important.

Standards

The value of keeping regular records of the dust pollution in all of the departments throughout a plant cannot be overestimated as a safeguard. In this direction, it must be noted that *regular* records were mentioned, not merely records. It is more impressive to a judge and jury to hear that dust counts were taken in each department weekly than that they were taken on Monday and Tuesday of one week and then on Thursday of the week following, and then, after an interval of two weeks, counts were taken on three days of week following. Regularity breeds efficiency and efficiency leads to confidence.

Very often in court cases or referee hearings, arguments ensue over the technique of dust sampling and the worth of the instrument used in making the counts. While there is no absolutely reliable way of interpreting the results of dust counts as made with one instrument into commensurate counts of another, for most instruments will differ in the results obtained at any one location, it does not necessarily follow that the instruments are unreliable and hence worthless. Repetitive readings taken at the same spot will verify the reliability of any of these instruments. Since standards as set up by medical authorities for the maximum permissible concentration of dusts often indicate the dust counting instruments with which these standards were obtained, certain court counsels try to make much over the fact that other than these instruments may have been used by a plant in its control work, and as a result the plant's control program should be minimized. The plant's counsel can, of course, counter with the veritable fact that all approved dust counting instruments, while differing slightly in performance, taken by and large will give the same general answers. That is, unsafe locations will be shown up as such, while safe operations will be indicated just as definitely. However, one simple expedient which is almost unanswerable, which is bound to impress a jury, judge or referee profoundly, and which is an interesting check in itself, is being adopted by certain plants. The writer has done it for years, and unhesitatingly recommends it. Immediately after taking the dust counts within the plant, the technician should take about three counts at varying distances from the plant and always in a direction counter to the prevailing wind (which should be recorded). At least one count should be taken in an admitted residential neighborhood, while the remaining counts should be taken in busier locations, one being a well-known business center relatively free from visible dust. Due to the fact that almost any city or town location during the hours from 12 noon to about 5 p.m. will disclose a surprising amount of extremely fine air-borne material to the dust counter, in most cases well above what would be found in any plant with good dust control, concrete evidence of the plant's hygienic standards are available which will impress the lay mind more than the mere figures pertaining to the plant itself.

Examinations

The subject of physical and X-ray examinations of employees is a ticklish one. While it is readily agreed by all parties concerned that it is a fine thing to give these examinations, it is the procedure following the diagnosis which causes such intense controversy. Where a man is shown to be unfit for any active work, obviously it is to his benefit to be shifted to an easier job requiring less physical exertion. Or, if he has contracted tuberculosis, it certainly is imperative that he be isolated from his fellow employees to avoid contagion. Secondary, but almost as important, is the necessity for treatment for the tubercular himself.

It is just as wrong for labor to object to examinations on the ground that disclosure of ailments may affect the individual's position as it is for management to hesitate because shifting or termination of an employee's work may result in a court action for damages. As for the management's headache, lack of proper action after proper diagnosis can at best only defer the employee's complaint, while at worst it may, by virtue of the previously stated contagion, result in the same condition amplified many fold. Labor's objections, if existent, can be answered with almost the same arguments. Not only will a disabled employee, by his very disability be forced out of employment sooner or later, but by delaying, he may be seriously endangering those about him as well as interfering with his own treatment, whatever that might be. State laws in effect at present in most states, and Federal laws most assuredly to follow, will fix compensation schedules, as well as prescribe methods for the affixing of responsibility. Hence, it behooves management not only to do all in its power to protect its employees' health, but to protect itself by the adoption of a real set of commonsense policies in dust control.

Estimating Heat Flow Through Sunlit Walls

Part 5 — Comparison of Various Methods

By C. O. MACKEY† and L. T. WRIGHT, JR.‡

In last month's issue, the authors' concluded their presentation of data on estimating heat flow through sunlit walls. This concluding part presents a comparison of results obtained by the Mackey and Wright method as compared with other well known methods for estimating sun heat flow.

The results presented in these articles may now be compared with temperature differentials that have been used in estimating cooling loads by some of the air conditioning companies. Since the appearance of the first articles, a new book by Carrier, Cherne, and Grant called "Modern Air Conditioning, Heating, and Ventilating" has been published. A table in the book gives temperature differentials to be used in estimating the effect of air temperature difference and solar radiation upon the cooling load; this table has been used for some time by the Carrier Corporation in estimating loads but has not been published before. In this table, walls have been divided into three groups: (1) frame construction, (2) less than 8 in. of masonry, (3) more than 8 in. of masonry. Roofs are also divided into three groups: (1) light construction, (2) medium construction, (3) heavy construction. The temperature differences given in these tables are multiplied by the overall coefficient of heat transfer to get the actual rate of heat transfer to the indoor air.

In the "Trane Air Conditioning Manual," tables of *excess* temperature differentials are given to allow for sun effect. These temperature differences are added to the air temperature difference and the sum multiplied by the overall coefficient of heat transfer in order to obtain the rate of heat transfer to the indoor air due to air temperature difference and sun effect. In the preparation of these tables, a uniform time lag of two hours was assumed. The tables are first subdivided according to latitude, and each latitude table is further subdivided into three parts depending upon the color of the surface of the wall or roof. There is no subdivision of temperature differential on the basis of wall or roof construction.

William Goodman gives tables of excess temperature differentials for walls and roofs to allow for sun effect in *Heating, Piping, and Air Conditioning*, May-October, 1938. Like the tables in the Trane Air Conditioning Manual, these tables are subdivided according to latitude and color. Goodman states "for walls and roofs of ordinary construction, the time lag is probably about from two to four hours."

A comparison of the results given in these four different tables may be of interest. First a wall of frame construction (dark paint) facing SW will be considered. Since there is no further subdivision in the Carrier tables for frame construction and no subdivision at all in the Trane or Goodman tables for any type of construction, the authors' tables for no insulation will be used. The comparison is shown in Table 11A.

TABLE 11A

Sun Time	Total Temperature Differential			
	Mackey and Wright	Carrier, Cherne, and Grant	Trane Manual	Goodman (2 Hr. Time Lag)
8 A.M.	5	5	0 + 3 = 3	0 + 3 = 3
10 A.M.	13	10	0 + 8 = 8	0 + 8 = 8
12 Noon	28	40	0 + 12 = 12	0 + 12 = 12
2 P.M.	41	50	11 + 15 = 26	9 + 15 = 24
4 P.M.	42	55	32 + 15 = 47	28 + 15 = 43
6 P.M.	38	55	31 + 13 = 44	27 + 13 = 40
8 P.M.	27	50	0 + 11 = 11	0 + 11 = 11

Next, consider a 4-in. concrete wall facing NW; the comparison is shown in Table 11B.

TABLE 11B

Sun Time	Total Temperature Differential			
	Mackey and Wright	Carrier, Cherne, and Grant	Trane Manual	Goodman (Medium Color; Two Hour Time Lag)
8 A.M.	3	10	0 + 3 = 3	0 + 3 = 3
10 A.M.	6	10	0 + 8 = 8	0 + 8 = 8
12 Noon	12	10	0 + 12 = 12	0 + 12 = 12
2 P.M.	22	10	0 + 15 = 15	0 + 15 = 15
4 P.M.	28	15	0 + 15 = 15	0 + 15 = 15
6 P.M.	29	15	15 + 13 = 28	17 + 13 = 30
8 P.M.	25	15	1 + 11 = 12	1 + 11 = 12

As a third and last comparison, consider a horizontal roof with 4 in. of concrete, 2 in. of insulation, and a black surface; the comparison of temperature differentials is shown in Table 11C.

The differences between the results obtained by using the four tables may be explained by a comparison of methods used in forming the tables. As explained in the previous articles, the authors' tables are based upon a graphical correlation of many solutions of the partial differential equation for unsteady heat flow for walls of different materials and orientations. For walls of one

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‡Instructor of Heat-Power Engineering, Cornell University.

material, solution of the differential equation followed the method explained by Alford, Ryan, and Urban in the *American Society of Heating and Ventilating Engineers Journal Section* for July, 1939. For composite walls, the authors used a method of finite differences originally proposed, in part, by E. Schmidt. The essential difference between the Trane tables and the Goodman tables is that a time lag of 2 hours is used in forming the Trane tables, while the choice of time lag is left to the user of the Goodman tables. Actually, of course, the time lag depends upon the thickness, thermal diffusivity, thermal conductivity, and orientation. The other uncertain point in the otherwise complete theory presented by Goodman concerns the portion of the heat entering the outside surface of the wall that actually reaches the air inside the conditioned space and constitutes a load on the cooling equipment. In the preparation of his tables, Goodman assumed that 50% of the heat entering the outside surface of every wall and every roof actually reached the indoor air. Obviously this fraction, like the time lag, also depends upon the various thermal properties and dimensions of the wall or roof; Goodman pointed this out when he wrote "assuming a constant percentage for the solar heat transmitted through a wall cannot be defended on theoretical grounds." No information is given concerning the basis of the Carrier tables for temperature differential, and no comparison of basic methods can be given. In the Carrier table, the temperature differential is given to the nearest 5F, and this is certainly as close as the cooling load estimate can be made.

TABLE 11C

Sun Time	Total Temperature Differential			
	Mackey and Wright	Carrier, Cherne, and Grant	Trane Manual	Goodman (4 Hr. Time Lag)
8 A.M.	14	20	0 + 3 = 3	0 + 3 = 3
10 A.M.	29	30	30 + 8 = 38	0 + 8 = 8
12 Noon	48	45	56 + 12 = 68	26 + 12 = 38
2 P.M.	61	45	65 + 15 = 80	50 + 15 = 65
4 P.M.	62	45	56 + 15 = 71	58 + 15 = 73
6 P.M.	55	40	30 + 13 = 43	50 + 13 = 63
8 P.M.	44	35	0 + 11 = 11	26 + 11 = 37

Many engineers dismiss this question of the estimate of solar heat gain with a shrug and a muttered comment that it is all a guess anyhow. The amusing part of this picture is that these same engineers will then accept as sacrosanct published values of other items constituting cooling load, such as heat and water vapor evolved by humans, infiltration through windows and doors, overall coefficients of heat transfer, and the heat evolved by a baker's oven, an egg boiler, a cigar lighter, or a curling-iron heater.

Red Hook Housing Project Oil Heated

Oil burners capable of burning a total of 1400 gal. per hour were installed in Red Hook Houses, the nation's largest public housing project, covering 40 odd acres in Brooklyn, New York.

Construction of this immense project was begun early in 1938 and it was ready to receive its first occupants in the Fall of 1939. The project was made possible by the U. S. Housing Authority at a cost of over $12,000,000, and was carried through to completion under the supervision of the New York City Housing Authority.

There are 25 six-story brick apartment houses constructed in the form of a T with each unit containing a hundred dwelling units of from two- to six-room apartments. All told there are 2545 apartments, kitchens and bathrooms; 10,650 rooms; housing some 2500 families or a community of approximately 10,000 people, at an average monthly rental of around $25 for each family. In addition there is a community building, children's recreation building, and a store and small apartment building. Adjoining are a park and playground, tennis courts and other recreational facilities.

The modern heating system consists of seven separate boiler room units located at strategic points supplying heat and hot water to a group of buildings. Each boiler room unit contains four Scotch marine type boilers rated at 125 hp. On each of three boilers in a unit is mounted one Enterprise semi-automatic No. 6 heavy oil burner, and for the fourth boiler an additional burner of the same size and make but fully automatic and with gas-electric ignition. There are a total of 28 heavy oil rotary burners each rated at 165 hp. of 50 gallons per hour capacity.

The heating system is so designed that each building controls its own supply of heat through a separate temperature control. Each of the 28 boilers is operated at a constant steam pressure of from 8 to 10 lb. and fired at 125% rating. All boilers are equipped with automatic feed water regulators, low water cut-off, pressure limit control and Sylphon damper regulators. There is a total of 285,350 sq. ft. connected heating load, plus hot water. Oil storage consists of seven 16,000-gallon tanks, and though no accurate figures are available, it is estimated that approximately 2,000,000 gallons of No. 6 heavy oil were used during 1940. The fuel oil pumping system is engineered and cross-connected in such a manner that there is a reserve pumping unit to insure against any interruption in fuel oil supply.

THE EDITOR'S PAGE

The American Petroleum Industries Committee has issued mimeographed sheets showing how much the tax on fuel oil as proposed by the Boland and Flannery bills would cost oil-burner owners. One of the sheets points out that both Representatives introducing these bills are from Pennsylvania, which would seem to imply that coal interests are behind the bills, and also mentions that the United Mine Workers support the bills.

It is probably true that many oil burners are a distinct luxury; if luxuries must be taxed, presumably fuel for such burners is taxable. On the other hand many stokers are likewise luxuries and such coal as is used by them is probably luxury-taxable. In that case, why should that gas burned by gas conversions or gas boilers be exempt?

There are two subjects which, it seems to us, baffle everyone, including the experts. One is the monetary question; the other is taxation.

Use of taxation on a competitor's product to obtain a competitive advantage is the height of unfair trade practices and likewise introduces complications into an already complicated question. We hope that it is only a coincidence that these bills to tax oil were introduced by Congressmen from a coal producing state. Whether it is or not, the fact that tax laws are formulated by the hit-or-miss methods that are used is an indictment of much of our system of taxation.

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Things have moved fast in St. Louis since a year ago when that city passed its anti-smoke ordinance. The ordinance was pretty severe on the soft coal producers in requiring that heating plants burning high volatile fuel must employ mechanical fuel burning equipment to burn the coal smokelessly or use smokeless fuel.

The treating of the coal to make it smokeless has been found to be quite expensive, so that fuel men in that region have worked hard to develop fuel burning equipment of the non-smoking type so low in cost that it could be afforded by the some sixty thousand St. Louis families who still heat with stoves.

Result is that two new devices have been developed. One is a vertical partition for the firebox so that fuel can be charged on alternate sides so as to enable the volatile from the newly-charged side to be ignited by the hot fire on the other side. Second device is a rotating two-grate affair revolved by a crank, one grate being charged at one firing, first rotating it to the fire door.

Both of these arrangements are controlled by a southern Illinois coal company which is reported as licensing furnace manufacturers to include them in their new lines. It has happened before and this may be a case when it happens again, that a threatened evil turns out to be a later blessing.

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Almost simultaneously with the outbreak of the war the Profits in Air section was inaugurated in this publication, with the primary objective of presenting to our readers more complete information on industrial building heating, ventilating and air conditioning.

These articles anticipated by some months the rise in industrial building and consequently have tied in with current activity in a gratifying way.

Even those who are engaged directly in defense building work must be surprised at the tremendous extent of new industrial plant building as reflected in the Dodge building statistics which show that for the first quarter of 1941:

(1) Building contracts are up 58% over 1940;

(2) Government contracts for defense construction account for half this gain;

(3) While residential building is one-third greater than last year, *factory building is four times as great as in 1940;*

(4) *Factory building for 1941's first quarter is higher than for any quarter since Dodge records began in 1925;* and

(5) *1941 factory building exceeds 1929 by 48%.*

Translate these condensed cold statistics into terms of boilers, radiators, pipe, valves, unit heaters, controls, heavy oil burners, stokers and fans, and into terms of engineer, draftsman, designer, steamfitter and sheet metal worker man-hours and the result represents the greatest output of this industry's plants, engineering offices, and contracting shops that this country has yet seen.

As amazing as these figures are, however, they do not tell the whole story about factory mechanical equipment. In 1925 and 1929 air conditioned factories were pretty rare; today's defense construction includes huge air conditioned structures such as those under way by Ford, Buick, Studebaker, Curtiss-Wright and others. But this is still not all, for the grinding, buffing, plating, cleaning, and similar processes in today's modern factory are practically all such that exhaust ventilation is required. Added to this, cooling has become commonplace in precision machine shops, and means for a high degree of air cleaning in certain departments are being widely adopted.

And indications are that the peak of this work is yet to be reached.

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The current definition of air conditioning states that control of both physical and chemical conditions of the atmosphere within any structure are included, and specifically mentions temperature, humidity, motion, distribution, dust, bacteria, odors and toxic gases. Two factors which, it would seem, should also be covered are noise and pressure. The reason for the first is obvious; as for the second it seems that the necessity for maintaining a given barometric pressure in the stratosphere planes alone is sufficient justification for including this factor.

The phrase *within any structure* may, perhaps sooner than we expect, be omitted from the definition. Recently, in a chance encounter on a train with J. F. McIntire, past president of the ASHVE, he told us his story of the mules in Texas which had become stiff jointed from breathing sulphur fumes from a nearby plant; he went on to say that air conditioning of the outdoors may eventually be an important phase of engineering, and said that he recommended young engineers to consider this as a possible future field of endeavor.

All of which leads to the conclusion that the all-round air conditioning engineer twenty or even ten years from now is going to have to be a pretty well informed individual who will, more than ever, need all the help and information he can get from technical books, magazines and societies.

UNDERGROUND STEAM PIPING

INCLUDING TECHNICAL DATA BY

JOHN F. COLLINS, JR.

SECRETARY, NATIONAL DISTRICT HEATING ASSOCIATION

HEATING and VENTILATING'S REFERENCE SECTION

2

STEAM DISTRIBUTION PIPING

By JOHN F. COLLINS, JR.

Secretary, National District Heating Association

The purpose of this section is to outline the problems faced by an engineer in the design of a distribution system for either a district heating utility or private central plant for group building heating, and, further, to indicate either the solution of the problem or where detailed information may be obtained; further, to show by presenting selected examples, some typical actual installations of steam distribution piping, how these problems have been met in the field. Illustrations have been assembled by the editors with, in the case of the applications, the cooperation of the industry.

Underground piping is, in a sense, the foundation on which the whole district heating business is built. This being so let us first define District Heating. It is surprising how many people there are who have never heard of it, or at least have a very vague idea of its scope even though they have frequently experienced the comfort and convenience of the service. Others place limitations upon it much narrower than it actually should have.

District Heating may be defined as the furnishing from a boiler plant or plants, of heat, usually in the form of steam or occasionally hot water, to at least two or more buildings for space heating or other uses.

Examples

There are many examples of the simplest form of district heating where two adjacent buildings are supplied with steam service from the plant in the basement of one of them. The most complex example is the furnishing of steam service for space heating and many other purposes by the New York Steam Corporation from the 28 boilers in its several plants through many miles of steam lines to almost 2000 large customers—among them the Empire State Building and Rockefeller Center—all in the heart of Manhattan.

Between these two extremes are not only the systems in the business centers of the other great cities of the United States, Canada and Europe, but thousands of other systems by means of which the buildings of schools, universities, hospitals and other institutions, residence districts, apartment house groups, commercial establishments, housing developments, manufacturing plants, army camps and fortifications, are furnished with steam service.

Some of these systems are owned by public utilities, others by municipalities, states or other governmental agencies, and still others by private individuals or corporations. Some (a) organizations are in the business of selling steam or hot water. Others (b) are in the real estate or management business, and with them the cost of furnishing heat is a factor in figuring the rental they must charge. Still others (c) are simply furnishing service to groups of buildings which they themselves operate or use.

Costs

Steam service being in competition with other forms of heating, such as individual plants burning coal, gas, or oil, it is quite evident that organizations in the first group (a), selling steam, are quite concerned in keeping the cost of producing and delivering the product to a minimum as well as in seeing that their customers use no more than is necessary to do the heating or perform the service they desire. Otherwise, the customer will be dissatisfied and may turn to the competitive forms of heating.

Though possibly less evident, it is equally true that those who superintend income properties (b) and buildings (c) which their own organizations use, should be ever alert to keep their steam costs to a minimum. Lowered heating costs, just the same as improvements in other operations, permit lower rentals or the sale of services or products at a decreased price, thus overcoming competition from other services or methods.

Lowered heating costs imply lower steam costs. How can these steam costs be made less? This question breaks down into two others:

(1) How can a satisfactory plant—by which is meant both boiler plant and distribution system—be installed, ready to operate, to the best advantage for the smallest possible investment, thereby resulting in a lower interest charge which must be met out of income from some source, be it steam revenue, rent, commodity income, tuition or state grants?

(2) Once built, how can this property be operated to produce steam at the lowest unit cost?

When the steam generating and distribution system is ready to operate, an irrevocable step has already been taken. The plant has been built, the investment has been made. Therefore, the interest that must be paid on this investment is established. It is then too late to save interest charges except when future extensions are made. Thereafter, only operating economies are to be obtained. Thus the value of the best design and construction becomes apparent.

Utilization

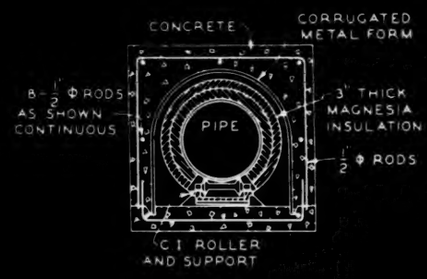
Of course, it is also possible to show those in charge of the buildings in which the steam is being used how to get the most out of the product. This is the usual practice of the utility companies selling steam. The means have been quite well determined and much has been written on the subject.† Therefore, it is unnecessary to consider this subject further here, except to reiterate that what is good practice in the utilization of steam in buildings where it is purchased is likewise the proper procedure where it is generated in a plant on the same property such as is found at universities, in apartment groups, and similar group building projects.

Having outlined the desirability of good design in both the boiler plant and distribution system and of proper operation, both of the boiler plant and distribution system as well as the utilization equipment, the author proposes to confine the paper hereafter to the subject of design and construction of the distribution system, in the belief that this is the phase which requires the greatest attention and about which the least has been written. Were a major reduction in distribution cost attainable, it would become feasible to supply with district heating service of some kind many localities which it is at the present time not economically desirable to serve.

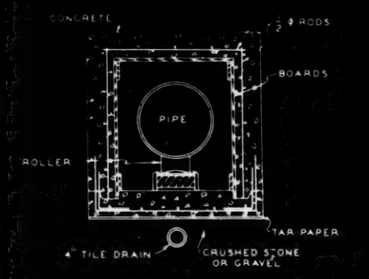
†Including the booklet prepared by the National District Heating Association in collaboration with the National Association of Building Owners & Managers, and entitled "Principles of Economical Heating".

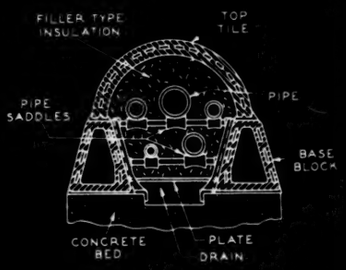
CONDUITS

(Upper right) Conduit used by many district steam companies. It consists of a reinforced concrete envelope with 4 in. walls which are increased to 5 in. when installed in streets. The inner form of the conduit is made of 20 gauge corrugated iron which is overlapped by two corrugations at the joint. Conventional cast iron rollers and supports are employed and 85% magnesia insulation is commonly used. Pipe supports are spaced at approximately 20 ft intervals.

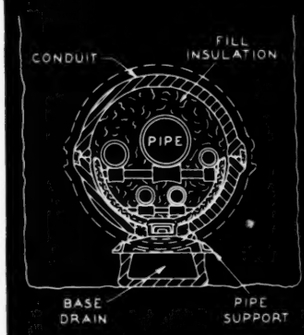


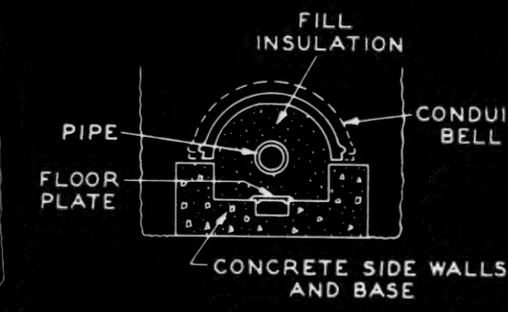
(Left) This is another example of conduit frequently used by utilities. It is constructed of concrete reinforced laterally and longitudinally with reinforcing rods. Inside forms are made of 1 in. matched boards. Pipe is supported on rollers which are set snug to the bottom of the pipe. (Right) H. W. Porter Therm-O-Tile features an internal drain and a concrete slab base. Insulation may be either sectional pipe covering or Thermobestos. Arched tiles are available from 6 to 24 in. in diameter and with five different size base tiles they produce 27 different conduit cross sections.



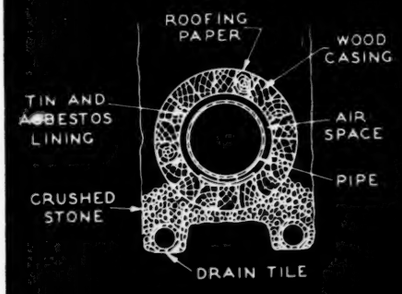


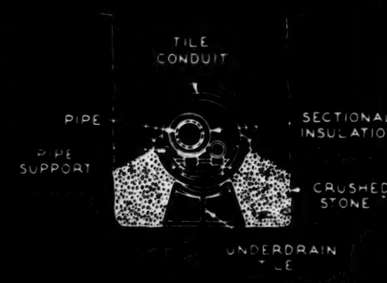
(Left) Ric-wiL conduit features a vitrified glazed tile conduit which is split on the job and re-sealed by a visible joint, cast iron pipe supports, and a base drain foundation which both supports the conduit and provides for drainage. Fill type insulation is employed. (Right) Ric-wiL Universal steam conduit which employs a conduit bell supported on either concrete or tile sides. Center drain is provided in concrete slab which acts as a support for conduit. Fill type insulation can be employed.



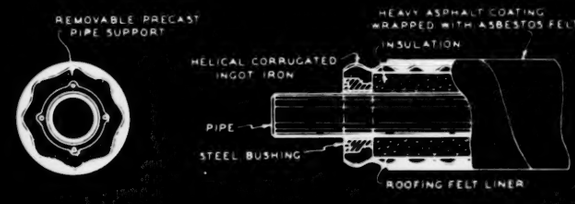


(Left) Adsco wood casing conduit requires no supporting structure or covering other than the back fill of the trench. Two drain tiles are placed at the bottom of trench, gravel fill laid over the tiles and then the steam pipe is placed in the trench. Wood casing is then slid under the pipe and pipe guide is inserted to carry the pipe. Casing sections are joined with a special pitch which is poured into the joints before they are driven tight. (Right) Adsco Bannon tile conduit which employs an underdrain tile. Conduit is constructed of vitrified glazed tile with recessed reinforcing ribs for pipe supports in the lower half. Crushed stone or gravel is used to back fill trench to approximately the height of the half section of conduit. Sectional insulation is employed.

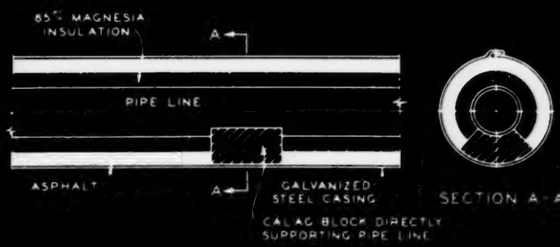




Ric-wiL insulated pipe units are available in completely assembled 20 ft lengths and consist of Armco galvanized conduit coated outside with asphalt and wrapped to a smooth finish with asbestos asphalt saturated pipe lined felt. Unit may be obtained with any standard insulation. Units are coupled with corrugated Armco coupler, which is fitted with a wrapping of heavy asbestos felt and all joints are sealed with high melting point mastic cement.



Ehret Durant insulated pipe is available in standard lengths completely assembled for installation. Insulation used is 85% magnesia which is surrounded with a layer of high melting point asphalt and a special Durant jacket. Pipes over 2 in. in diameter are supported with Calag block inserted in the insulation during fabrication. Sufficient bare pipe is left exposed at the end of the pipe lengths to permit making field connections. Connections are covered in the field with 85% magnesia insulation, a sheet metal pouring jacket is wired over the joint and a special asphalt is poured into the jacket.



LAYOUT OF THE ROUTE

The layout of a steam distribution system should be supervised by some person or organization specializing in this work and familiar with all phases of the subject. The steam utilities have long recognized the necessity of this and have employed personnel who in many cases devote their entire time to it. The engineers of the various companies cooperate through the N.D.H.A. Distribution Committee to determine the best methods of designing and constructing such systems.

Engineers and architects familiar with the steam layouts in office and other buildings are not necessarily, in fact probably are not, acquainted with the details of design and the methods necessary to produce the most economical layout of a system which in most cases is buried.

Probably there are locations today where inferior types of heating are being considered simply because district heating systems already in place were made too expensive because the designer did not know how to keep the costs to a minimum.

The following are some of the major points to be considered in designing a distribution system. Some apply to all layouts, others do not.

Determining the Route. This procedure can best be described by examples:

In Fig. 1 P is the boiler plant, while A, B, and C are buildings to be served. D is a building which might be served. There are many routes, one of which the designer must determine as being the most desirable, which may or may not involve the least immediate expense, to build. The different possibilities are illustrated in schemes 1 to 4, Fig. 1.

Comparative cost estimates, however, are needed.

(a) Consider Future Load. The lines should be so laid out as to permit the connection in the future of additional load with the least ultimate expense. For instance above, if D is not considered, schemes 1 and 4 may be the most feasible but otherwise 2 or 3 might be cheapest in the long run.

Along a city street the prospective load may be concentrated on one side, making it best, even at a higher immediate cost, to run the main on that side to avoid more lengthy future service lines crossing the street.

(b) Consider Load Location. It is desirable to make each section of line as small and as short as possible to give the desired service. Therefore, it is best to serve a large load as soon as possible in order that the remaining parts of the line may be smaller than otherwise. Thus if building A is larger by comparison than B and C, it may be best to run the line first to A.

(c) Consider Position of Boiler. Where it is being planned to serve existing buildings which have previously been supplied steam from boilers within their own walls and where the total interior and exterior piping costs are to be kept to a minimum, it may be more economical to extend the main along the exterior of the side of the building nearest to the boiler, even at greater expense for street main construction than simply to bring it to the nearest points of the buildings. Fig. 2 shows two alternate arrangements of hooking up existing boilers. In Fig. 2 the exterior main line cost in scheme 1 would be less, but when the cost of the extensions from this main to the boiler is considered, the total cost of scheme 1 may be more than that of scheme 2.

(d) Consider Regulations. When lines are to be placed in public places, such as beneath streets, municipal regulations must be considered.

(e) Consider Ground Use. On some locations in the grounds of universities, hospitals, and housing developments, activities of service and repair men may be generally undesirable due to damage to lawns, danger of accident, and so on.

(f) Consider Excavated Space. The locating of lines in the basements or sidewalk vaults—extensions of basements under sidewalks—of buildings is an economical procedure when it eliminates part of the excavation cost. However, the steps to be taken in getting a right-of-way and the difficulty of moving obstructions in these places, must be carefully weighed.

It is an advantage to place a district steam main within a basement not only to those paying for its construction but also to the owner of the building piping as its presence may make it possible to eliminate at least part of the building mains.

(g) Consider Future Property Development. In the early stages of design, it is desirable to consult with municipal authorities or the managers of the property in which it is proposed to locate the line to determine that the proposed construction will not conflict with their plans for future development of the property. Otherwise, before the end of the useful life of the line has arrived it may be necessary to abandon it.

Surveys

Assuming that the route of the distribution piping or main has been selected in a general way in accordance with the factors discussed above, the next step is to make a search of all existing records and a field survey.

The purpose in searching the records is to determine what underground structures lie within or near the proposed route.

This information is to be found on utility company maps and drawings, plans of buildings and grounds, municipal records and notes of previous construction.

With this information at hand it is much easier to make the field survey. In such a survey it is necessary to make the necessary measurements to locate existing building walls, curb lines, property lines, roadways, utility poles, fire hydrants or other surface structures. Likewise existing manhole covers, manholes, direct lines, utility pipes, valve boxes, sewers, catch basins, curb drains and all other accessible sub-surface structures must be measured to record their location. In order to obtain some of these measurements it is often necessary to enter manholes. Within these structures many times it is possible to obtain needed data not only on the utility for which the manhole was constructed, but also the location of the other lines passing through it.

If accurate records are not available showing the elevations of the ground, or roadway and structures, it may be necessary to make an instrument survey.

Where the records and examination or previous experience do not disclose the location of buried structures and the nature of the sub-surface material such as soil or rock, it may be necessary to dig test holes. Where hard rock is found, the increased cost of excavation might justify a change of route.

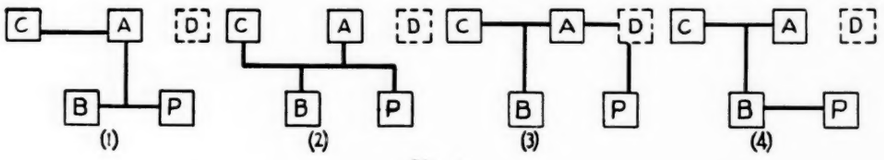


Fig. 1.

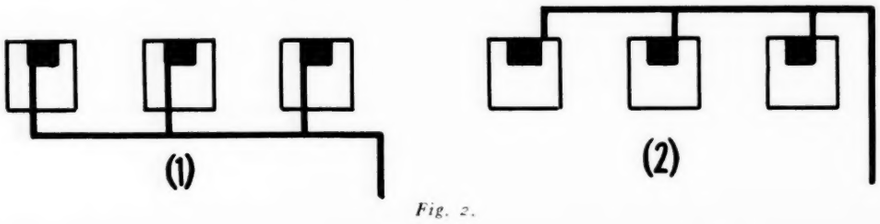


Fig. 2.

THERMAL LINEAR EXPANSION OF PIPE

(In Inches per 100 Feet)

Temp., F	Material			Temp., F	Material		
	Steel	Wrought Iron	Copper		Steel	Wrought Iron	Copper
0	0	0	0	390	3.156	3.291	4.532
10	0.075	0.078	0.111	400	3.245	3.383	4.653
20	0.149	0.156	0.222	410	3.334	3.476	4.777
30	0.224	0.235	0.333	420	3.423	3.569	4.899
40	0.299	0.313	0.444	430	3.513	3.662	5.023
50	0.374	0.391	0.556	440	3.603	3.756	5.145
60	0.449	0.470	0.668	450	3.695	3.850	5.269
70	0.525	0.549	0.780	460	3.785	3.945	5.394
80	0.601	0.629	0.893	470	3.874	4.040	5.519
90	0.678	0.709	1.006	480	3.962	4.135	5.643
100	0.755	0.791	1.119	490	4.055	4.231	5.767
110	0.831	0.871	1.233	500	4.148	4.327	5.892
120	0.909	0.952	1.346	520	4.334	4.520	6.144
130	0.987	1.003	1.460	540	4.524	4.715	6.396
140	1.066	1.115	1.575	560	4.714	4.911	6.650
150	1.145	1.198	1.690	580	4.903	5.109	6.905
160	1.224	1.281	1.805	600	5.096	5.309	7.160
170	1.304	1.364	1.919	620	5.291	5.510	7.417
180	1.384	1.447	2.035	640	5.486	5.713	7.677
190	1.464	1.532	2.152	660	5.583	5.917	7.938
200	1.545	1.616	2.268	680	5.882	6.122	8.197
210	1.626	1.701	2.384	700	6.083	6.351	8.460
220	1.708	1.786	2.501	720	6.284	6.539	8.722
230	1.791	1.871	2.618	740	6.488	6.749	8.988
240	1.872	1.957	2.736	760	6.692	6.961	9.252
250	1.955	2.044	2.854	780	6.899	7.175	9.519
260	2.038	2.130	2.971	800	7.102	7.384	9.783
270	2.132	2.218	3.089	820	7.318	7.607	10.056
280	2.207	2.305	3.208	840	7.529	7.825	10.327
290	2.291	2.393	3.327	860	7.741	8.045	10.598
300	2.376	2.481	3.446	880	7.956	8.266	10.872
310	2.460	2.570	3.565	900	8.172	8.489	11.144
320	2.547	2.659	3.685	920	8.389	8.713	11.420
330	2.632	2.748	3.805	940	8.608	8.939	11.696
340	2.718	2.838	3.926	960	8.830	9.167	11.973
350	2.805	2.927	4.050	980	9.052	9.396	12.253
360	2.892	3.017	4.167	1000	9.275	9.627	12.532
370	2.980	3.108	4.289	1100	10.042	10.804	13.950
380	3.069	3.199	4.411	1200	11.598	12.020	15.397

The above table is based on the formula

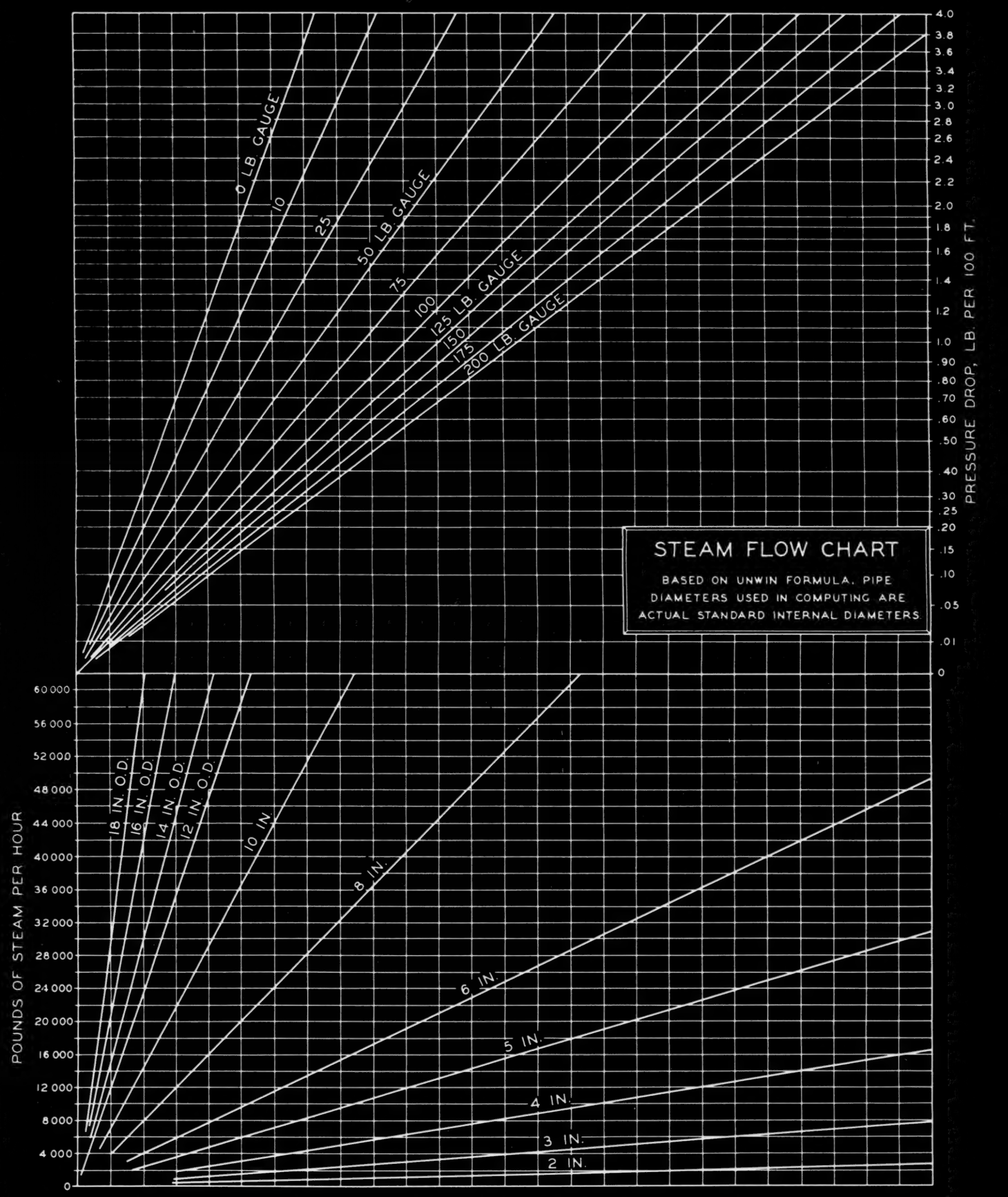
$$L_t = L_o \left| 1 + a \left(\frac{t - 32}{1000} \right) + b \left(\frac{t - 32}{1000} \right)^2 \right|$$

where L_t = the length at tF
L_o = the length at 32F
t = the final temperature in degrees Fahrenheit
a and b = constants as follows: steel, a, 0.006212, b, 0.001623; wrought iron, a, 0.006503, b, 0.001622; copper, a, 0.009278, b, 0.001244; cast iron, a, 0.005441, b, 0.001747.

Using zero as a base the table has been computed from this formula in order to simplify its solution. It is used as follows:

Example: A 740-foot steel pipe line was installed during 60F weather. What is the computed expansion of the line when 420F steam is turned on in the line?

Solution: Under "Steel," opposite 420F, find 3.423; opposite 60F find 0.449. Subtracting gives 2.974 in. expansion per 100 feet. For 740 feet the expansion is $7.4 \times 2.974 = 22.076$ in.


STEAM FLOW CHART
BASED ON UNWIN FORMULA. PIPE DIAMETERS USED IN COMPUTING ARE ACTUAL STANDARD INTERNAL DIAMETERS.
POUNDS OF STEAM PER HOUR
PRESSURE DROP, LB. PER 100 FT.
0 LB. GAUGE
10
25
50 LB. GAUGE
75
100
125 LB. GAUGE
150
175
200 LB. GAUGE
18 IN. O.D.
16 IN. O.D.
14 IN. O.D.
12 IN. O.D.
10 IN.
8 IN.
6 IN.
5 IN.
4 IN.
3 IN.
2 IN.

DESIGN OF PIPING SYSTEM

Pipe Sizing

The factors which enter into a determination of line size are:

(1) Maximum quantities of steam (usually in pounds per hour) to be delivered at the various buildings to be connected to it;

(2) Initial available pressure in pounds per square inch; and

(3) Allowable or desired unit pressure drop of the steam flowing through the line, usually expressed in pounds per hundred feet.

Before the first of these factors, maximum flow, can be obtained, it is necessary to secure or compute the maximum steam demands of all the buildings to be served from it. Having obtained these figures, the maximum flow of steam in each section of line can readily be figured.

When the new line is to begin at the boiler plant, the second factor, initial pressure, is known from plant operating practice. When it begins elsewhere, either a pressure gauge test may be necessary at the point of connection or a calculation of the theoretical pressure at that point.

Assuming for the moment that all other buildings served from the line require steam at the same service pressure as the building farthest from the start of the line, the total allowable pressure drop would be the difference between the initial and the service pressure of this building. This figure divided by the "equivalent" line length (which makes extra allowance for the greater friction in bends, valves and fittings) in hundreds of feet, gives the permissible unit pressure drop per hundred feet.

For example, assume that a line similar to that shown in Fig. 1, scheme 1, is to be designed, and further assume that the initial pressure at P is 11 lb. per sq. in., the service pressure at C is 10 lb., the length of line P to C is 370 ft., and that friction in the bends and fittings total sufficiently to equal an equivalent straight length of 30 ft. The pressure drop per hundred feet will be

$$\frac{(11-10)}{(370+30)} \times 100 = \frac{1 \times 100}{400} = \frac{1}{4} \text{ lb. per 100 ft.}$$

If, however, building C needs only 3 lb. pressure and the others 10 lb., then the pressure at A would govern loss and line size from P to A. The size of the line from A to C could be selected for a much higher drop.

There are a number of formulas which, once the above factors are known, can be used to determine line size. These give approximately the same results. Computations by the use of formulas, however, are complicated and charts such as the one shown in page 40, based on Unwin's formula, can be used to advantage.

Design Drawing

Following or during the making of the survey in the field, a drawing should be started showing by plan and cross-sections the locations of all the structures found in the field that might lie in the proposed route of the line extension.

The next step is to show on this drawing the exact location of the new line or extension and its relation to other structures as determined from the study which has been made and consideration of a number of factors which will now be outlined.

Depth of Line: The line should be located as near to the ground or street surface as good design, existing conditions and the rules of the authorities or the desires of the property owners will permit.

Obstructions in the path of lines must either be passed over or under or be moved. The best solution is probably a matter of cost. Small obstructions are usually moved. For example it probably may be less expensive to pay a municipality to move a fire hydrant connection than to lower a section line and conduit a foot or two to pass under it.

The greatest obstruction problem is at street intersections where not only the structures of the street in which the line is located are encountered but also those of the cross-street. As a result of conditions found at these crossings it often becomes necessary to lay lines very deep. For the installation of deep lines it is often best to excavate by the shaft and tunnel method rather than to dig a very deep trench.

The low points on lines must be so located as to be accessible, since at these points the condensed steam flowing in the bottom of the lines must be trapped out. Therefore, manholes are required unless it is possible to design so that the low points occur in other accessible places such as basements.

The problem becomes more complicated when a condensate return line parallels the steam main for then the depth selected usually must permit the gravity flow of the return water.

Paving: Considerable cost will be saved if a location is selected where it is unnecessary to remove paving and replace it, as is usually the case in installations on institutional grounds. In the public streets it is not often possible. However, when it is permissible to use the space below the sidewalk, it often will be found less obstructed and the paving easier to remove and replace.

Building Lines

The location of steam mains parallel and adjacent to building lines is sometimes inadvisable. This is because if a new building is built, activities such as the driving of piles and the construction of foundations may harm the conduit.

Other considerations in line locating includes difficulties experienced with traffic, wet earth and drainage, lack of a straight path for the line and conduit, and the cross-sectional dimensions of the conduit itself.

Selection of Conduit

Since it is necessary to protect the pipe line and its insulation from moisture and other damage that might occur to a buried line, and since the line must be free to expand and contract, underground piping in most cases is protected either by a conduit or else it is run in a tunnel. There are many kinds and types of conduit, some of which are available commercially and others designed and built on the job. Among the types of conduits are:

(a) Wood casing,
(b) Concrete,
(c) Combination building tile and concrete,
(d) Concrete pipe,
(e) Cell concrete,
(f) Cast iron,
(g) Precast concrete,
(h) Split tile,
(i) Prefabricated sheet metal, and
(j) Prefabricated corrugated ingot.

Some typical conduits are illustrated on page 37.

Cost in place is a foremost factor in selection of the type to be used, but there are others, such as:

← The Steam Flow Chart *shown opposite is a graphical solution of the Unwin formula. Standard inside pipe diameters have been used, so that in solving a problem involving 6-in. pipe, for instance, the user is safe in using the 6-in. line on the chart.*

In using this formula for pipe sizing it is advisable to compute each hundred foot section separately. That is, at the end of the first hundred feet subtract the pressure drop from the initial gauge pressure and reenter the chart for the second hundred feet, and so on until the end of the line.

The following example shows how the chart is used:

EXAMPLE: What will be the pressure drop in a 100 foot long 6-in. pipe line carrying 32,000 lb per hour of steam at 100 lb per sq in gauge pressure?

SOLUTION: Enter at 32,000 on the vertical scale, lower left, and move horizontally to the diagonal line labeled 6 in. From the intersection of the line and the diagonal move vertically to the diagonal line labeled 100. From the intersection move horizontally to the upper right scale and read 2.8 lb per 100 feet.

(1) Space required for installation;
(2) Strength to withstand external pressure. Cast iron has been used under railroad tracks;
(3) Imperviousness to water and provisions for drainage;
(4) Expected life; and
(5) Time required for delivery.

The phrase "in place" is used here because some conduits require wider trenches for installation, more paving removal and more repaving than others. Some require more labor than others to install.

Tunnels vs. Conduit

Tunnels are distinguished from conduit in that they contain sufficient space for men to pass along beside the pipes to inspect them and the structure itself. They may also be designed with space to hold additional or larger lines to care for future needs. Some tunnels are designed so that service lines may be connected at any point along their length. In others it is possible to connect the service lines to the main only in manholes. This is a disadvantage.

Tunnels often cost four or five times as much as a conduit would cost to carry a similar line. Therefore, it is desirable to weigh the advantages and disadvantages.

Once a conduit is built, it is necessary either to step-up the steam pressure or to build a parallel line to supply additional capacity. The building of the second line in conduit has advantages over the construction of the tunnel. First, it is not necessary to spend as much originally for the conduit line as for the tunnel. Second, in placing the new line, in conduit, there is an opportunity to run it past other buildings which then can be served at a smaller expense. Third, if the outer ends of the two lines are joined together, a loop is formed which increases the reliability of the service.

Tunnels are built of concrete or brick. Precast reinforced concrete sewer pipe has also been used for this purpose.

In concrete tunnels, expansion joints to take care of the expansion of the tunnel itself have been used, but these are unnecessary, since apparently the friction of the earth surrounding the tunnel prevents its moving with change in temperature. The joints are potential entrances for water, and consequently undesirable.

Manholes

These structures usually are needed to permit operation, inspection and maintenance:

(1) Where expansion joints are placed on the main;
(2) Where service lines take off the main and contain shut-off valves;
(3) At points along the main where shut-off valves and other equipment are placed, such as sump pumps, syphons and ventilating fans;
(4) At anchor points on the main;
(5) At low points for traps.

Manholes are expensive to build. There should be just as few as possible. The number can be decreased if each one is located so as to serve several of the functions mentioned. Usually at least one must be built for every 300 ft. of line.

Manholes ordinarily are of concrete or brick, although other materials have been used. It is important to see that the neck is large enough to permit all equipment to be removed. The smaller a manhole the less it will cost, but if made so small that workmen cannot easily operate and maintain the equipment in it, there is little or no saving. Ventilation is another problem. Sometimes fans are used to decrease the temperature so that men can work. At other locations a double entrance is constructed so as to create an air current.

Pipe Expansion

The generally accepted formula for expansion of pipe for 32 and 1800F is that of Holborn and Day as follows:

$$L_t = L_o \left[1 + a \left(\frac{t - 32}{1000} \right) + b \left(\frac{t - 32}{1000} \right)^2 \right]$$

where L_t = the length at tF
L_o = the length at 32F
t = the final temperature in degrees Fahrenheit
a and b = constants as shown on page 39.

The table on page 39 is presented for the quick and reasonably accurate solution of this formula.

Once the amount of expansion has been determined a method of providing for it must be considered. The expansion can be taken care of either by allowing the piping to expand freely by using expansion joints or bends, or loops can be placed in the pipe line to absorb the stresses set up as the pipe expands or contracts. The choice depends on local conditions, the amount of the expansion, steam pressures, costs and other factors.

Expansion in buried lines is usually provided for by means of expansion joints of either the slip or the corrugated types. Typical expansion joints are illustrated on page 43. In locations such as basements, where space is available, expansion can often be provided for by means of pipe bends.‡ The amount of expansion any bend will safely provide for can be obtained from charts.

Since it is necessary that the expansion in the pipe line should take place at the point where the design calls for it it is necessary to anchor the pipe line so that it is securely fastened to the ground or to some structure at predetermined points. Concrete bases are commonly used and placed deep enough to be stable.

Where the expansion device, whether it is an expansion joint or a bend, is placed in a manhole a widely adopted method of anchoring is to use double expansion joints with anchors midway between each manhole.

It is possible to connect services to mains at points other than anchor points, but it is less difficult if the connections are made at anchorages.

In the construction of lines, including valves and fittings, there are proper places for the use of cast iron, wrought iron, cast steel, wrought steel and forged steel. Just what should be used at any one place can be determined from the conditions of use and the Code for Pressure Piping, Section 4, District Heating.

Insulation

Underground piping is a complicated one and there is no space here to detail the methods of arriving at the proper thickness of insulation. One of the things which cause this matter to be complex is the determination of earth temperatures. The theory is further complicated by the fact that in comparing heat loss from a bare or covered pipe in air, data for which are in very good shape, it is necessary to keep in mind that with a pipe in the air the heat loss to the surrounding air and objects occurs by conduction, convection and radiation, while with a pipe buried in the ground the final heat loss is by conduction only. Consequently, it is not possible to apply the constants and equations which are used for pipes exposed to air to pipes buried in the ground.*

Many types of insulation can be used for underground pipe and among these are 85% magnesia and glass wool.

The matter of pipe insulation is tied in somewhat closely with the conduit, since certain conduits have provision already made for insulation and where these are commercially supplied the insulation is usually specified.

A third factor to be kept in mind in considering the insulation is that, just as in steam pipes in air, there is an economic thickness of insulation below which there is greater heat loss but lower first cost of piping insulation, and above which there is low heat loss but high insulation cost. Generally speaking, the economical thickness of insulation for underground pipe is reported as about ½ in. less than for pipes in air.†

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‡Based on tests by Crane Co., the formula for determining the size of U-bends for absorbing expansion is

$$E = \frac{.0052\ R^2}{d}$$

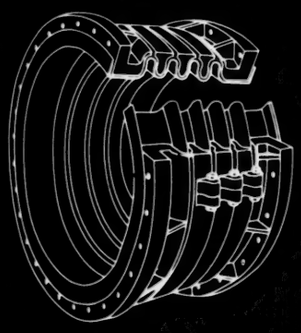
where E = the expansion in inches to be absorbed,
R = the mean radius of the bend, inches, and
d = the outside diameter of the pipe.
The formula is based on tests on pipe from 1 to 16 in. in diameter.—Editor

*For a summary of information on steam pipe insulation for underground pipe the reader is referred to the Handbook of the National District Heating Association. The Proceedings of the NDHA also contain considerable information on ground temperatures around buried steam pipes.—Editor.

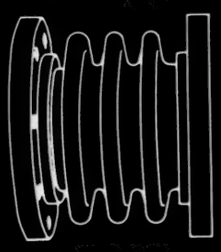
†The chart on determining economical thickness of insulation of pipes in air designed by the late L. B. McMillan of Johns Manville and presented before the National District Heating Association in 1927 can be used for determining the economical thickness of pipes in air.—Editor.

EXPANSION JOINTS

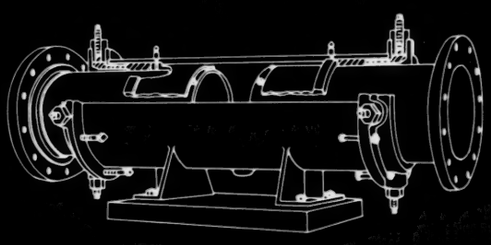
A self-equalizing corrugated-type packless Badger expansion joint. Copper frequently used as flexing member but also available with steel, stainless steels, or other alloys as flexing members. Feature of this type of joint is that for each size the graduations in traverses form a straight line; the step-up is uniform. Equalizing rings control flexing movement so as to distribute flexing over whole member.



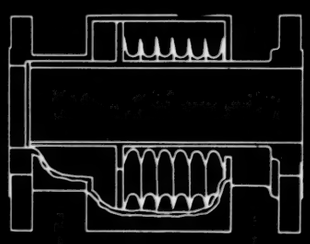
Badger corrugated-type expansion joint of the non-equalizing type. Made of either copper or stainless steel. This type recommended for use on any traverses up to and including ½ in., on pressures up to 25 lb, and on lateral displacements up to ⅛ in. per corrugation. Monel metal sleeve recommended with copper joint where superheat exists.



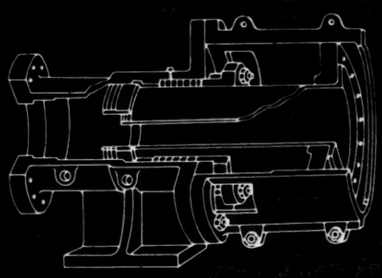
Feature of the Yarway Gun-Pakt double-end expansion joint at the right is use of a fixed gland ring by means of which packing may be forced into the stuffing box while joint is under pressure. This joint is also available in single end type with or without base and in welded types as well as flanged design.



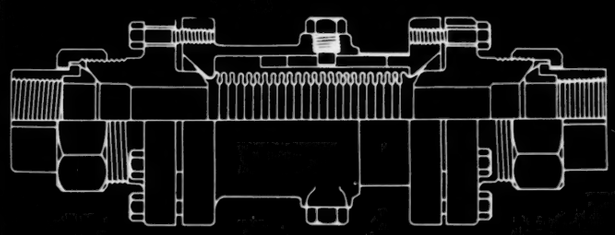
Longitudinal section at the right illustrates the Adsco Packless expansion joint, U-ring type, in which a series of welded U-rings is welded to the steel body and the guide on movable sleeve to form a permanent seal between the stationary body and the movable sleeve. Element is enclosed in steel case and is guided at three points. Furnished with flanged or welded ends with traverses of 1 to 4 in. in single joint.

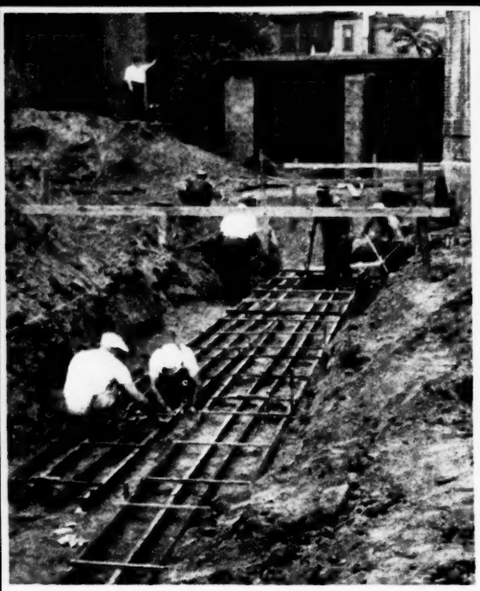


Adsco piston-ring expansion joint which can be packed or repacked under full pressure. Available in single or double joints with traverses of 4 to 12 in. per slip. Piston rings hold the line pressure during unpacking operation. Guide ring acts as stop to prevent slip from pulling out of body. A relief chamber and vent exhaust steam which passes rings during unpacking operation, relieving pressure from stuffing box area.

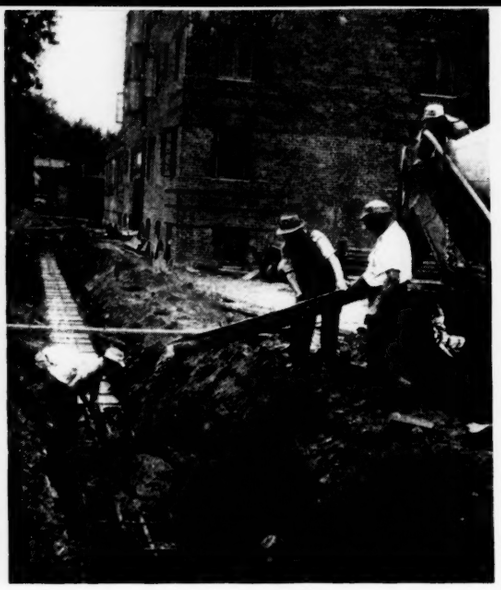


The Fulton Sylphon packless expansion joint at the right has a Sylphon bellows to absorb expansion. Designed for use on steam pressures up to 15 lb per sq in., this particular type is intended primarily for risers and other building applications. Also available for water lines. Advantage of expansion joints in building use is saving of rentable or usable space.





1 These 8 photographs illustrate the laying of a typical underground conduit. The above photo shows how the forms for the concrete base are prepared.



2 Method of pouring the concrete into the forms. It is necessary that forms be placed on solid earth and staked down so that pouring will not disturb the grade.

3 After pipe supports have been put in place on approximately 12 ft centers and concrete has hardened, the steam fitters install the heating pipes on the supports.

NEWARK HOUSING

On this page and the six pages following are described some recent applications of underground steam distribution systems. The projects were selected principally because they are typical of recent steam distribution practice. This first article was prepared by W. G. Benner, Jr.†

SIX low-rent slum clearance housing projects are now under construction by the Newark, N. J., Housing Authority Ltd., in co-operation with the United States Housing Administration. The second largest of these projects is known as the Seth Boyden Court and is located on the site of the former Dreamland Pleasure Park—on one of the main highways approaching the city in the heart of an industrial section. The front of the project faces U. S. Route No. 27 and the back of the project overlooks Weequahic Park which is the second largest park in Essex County.

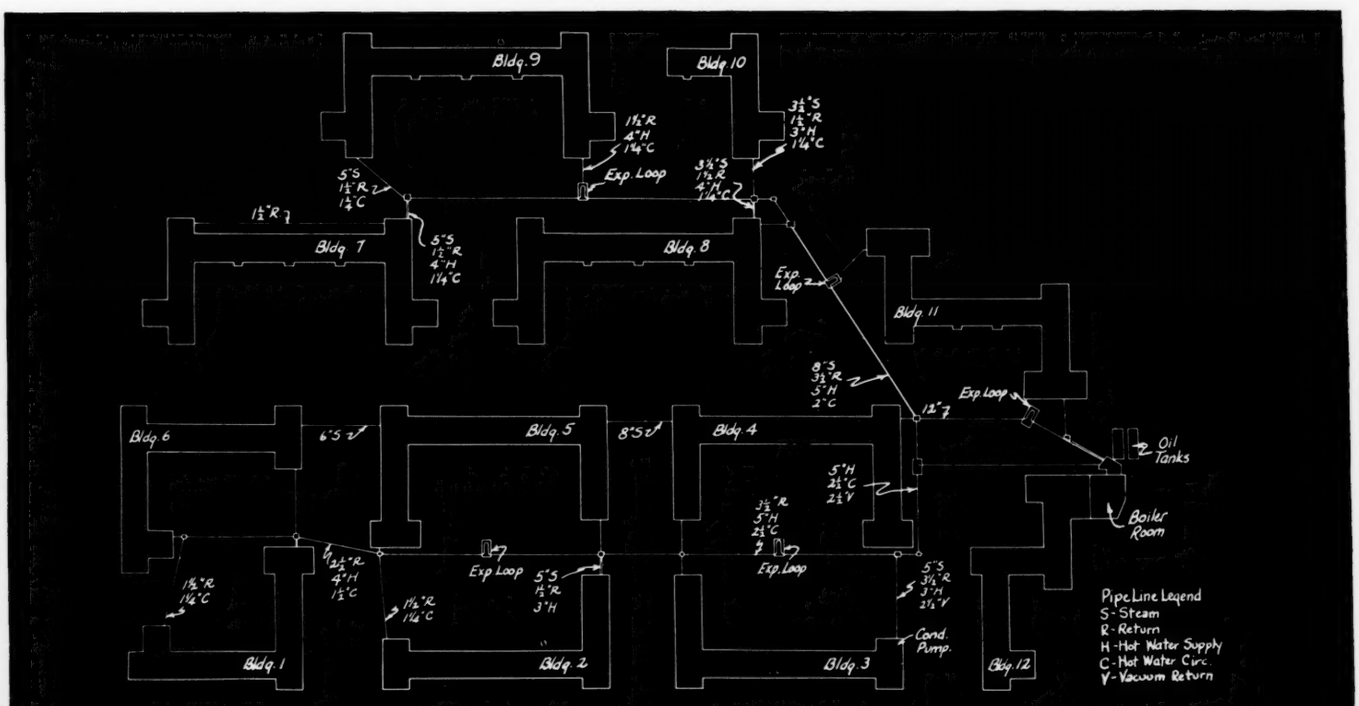
The area of the tract is 16 acres. On it this project was built, consisting of twelve buildings as shown in the accompanying plan drawing. In these twelve buildings there are 530 home units. When the project is completed it will have three playgrounds for the children, three-quarters of a mile of paved roadways, 50,000 sq ft of sidewalks, 24,000 sq ft of clothes drying area, a community hall, and a medical clinic.

The project is rapidly nearing completion. Since November 1, 1940, when 172 families moved into the new buildings a total of 344 families have been housed. It is believed while this is being written that by June 1, 1941, the remaining 186 families will be occupying their new homes.

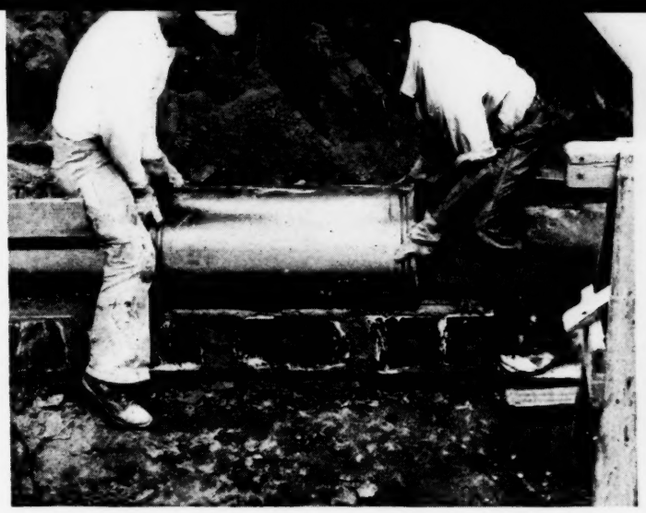
Since the project was opened in sections, the steam distribution system had to be completed in stages and in time to supply those buildings which were to be occupied. There are three 215 hp boilers which furnish the steam heat. These boilers,

†Engineer, H. W. Porter & Co.

Schematic diagram of the steam distribution system in Seth Boyden Court, Newark, N. J. Approximately 3500 ft. of underground conduit was used for protecting the heating mains.



4 After pipe lines have been tested then insulated tile fitters place the base tile on the concrete slab.



5 Two tile fitters then place the arch tile after mortar has been laid on top of base tile.

with their two 12,000 gallon oil tanks, had to be tested and placed in service as well as the two 4,000 gallon hot water generators which furnish the domestic hot water. The oil burners are supplied with number 6 oil.

Grading, though, was the most difficult problem here owing to the flatness of the tract of land. Flatness may be desirable for amusement parks, as in this instance, but as most heating contractors know it is not desirable in the steam heating business. The grade of the tract, starting at the highway, was found to be only a few inches higher than the highway itself, and it graded upward in a very slight incline toward Weequahic Park 800 ft in the rear. And in this connection it is interesting to note that the elevation of this highway is somewhat less than 12 ft above the mean high water which establishes the limits to which the depth of any underground work can ordinarily be satisfactorily installed.

The landscaping required that the finished grade of the project would be terraced above the highway which required considerable fill work. This was done late in 1939 before any other work was started and permitted the soil to become compacted with the subsequent freezing and thawing.

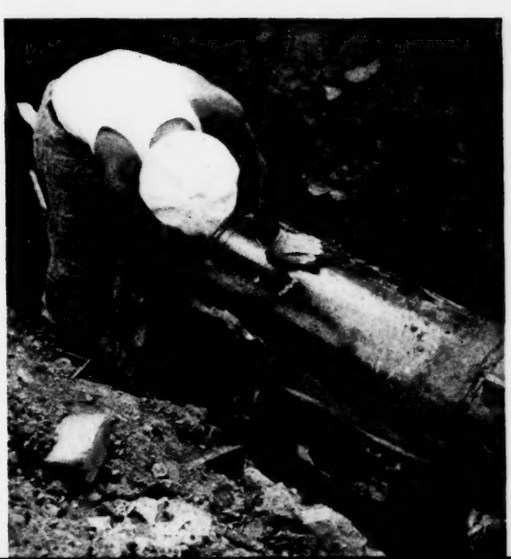
Obviously, some close figuring was necessary. The lowest elevation to which the conduit could be placed at the boiler room was determined by the suction line of the condensate receiver. The conduit entered the boiler room at an elevation of approximately 6.5 ft. The finished grade at the end of Building No. 1, which is approximately 1,100 ft away from the boiler room, was established at 12 ft. Therefore, the invert of the conduit at this point was placed at an elevation of 8 ft. This would give the maximum possibility of only an 0.18% grade for the return line to be pitched back to the boiler room. Clearly, this small amount of pitch was not sufficient for the conduit as it would not enable the condensate to flow back to the boiler room by gravity. The pitch was therefore increased and a condensate pump was installed in Building No. 3 as indicated in the plan drawing. This condensate pump takes care of the condensate from Buildings No. 1, 2, 3, 4, 5, and 6.

The elevations of this gravity return system were such that if they were to be maintained they would have to be run outside of the buildings. Otherwise, if permitted inside, the lines would be running directly through the openings of the windows and doors.

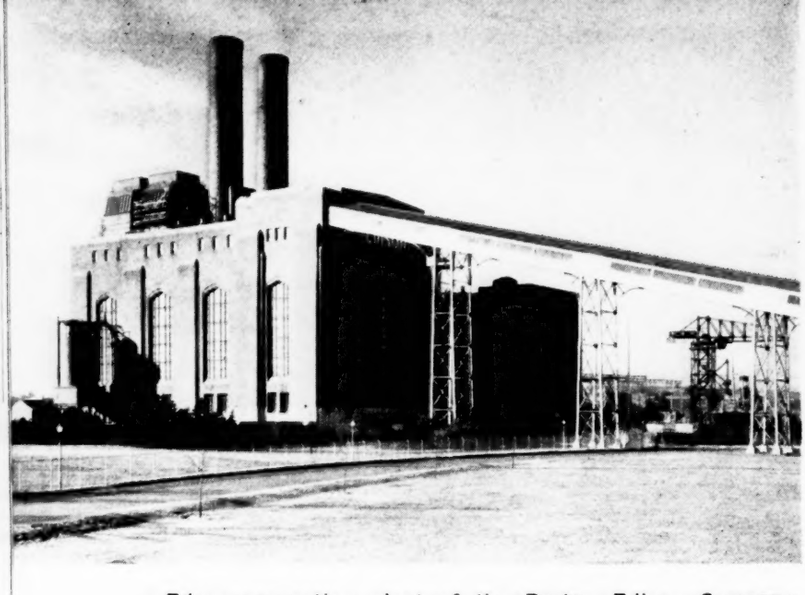
The necessity for the absolute grading to establish elevations of the conduit system became apparent, and the consulting engineers, Runyon & Carey, of Newark, N. J., took the greatest precaution in their specifications that the underground conduit should be installed upon a concrete slab.

6 Tile fitters fill the joints between tiles with mortar and trowel it smooth after arch tile has been placed.

7 After the mortar has set all of the mortar joints are waterproofed with a trowel coat of asphalt mastic.



8 After tile has been installed junction boxes and manholes are installed. Below is the completed conduit.



Edgar generating plant of the Boston Edison Company at Weymouth, Mass., which supplies steam at 1250 lb to Procter and Gamble plant approximately two-thirds of a mile away.

High pressure steam lines run above the ground from the generating plant to the point at which they enter the tunnel near bridge. Procter and Gamble factory can be seen on the far side of the river.

PROCTER & GAMBLE

ONE of the most interesting jobs of steam line engineering, and the first high pressure steam line of its length, is that recently completed by the Boston Edison Company. It extends nearly two-thirds of a mile from the Edison company's Edgar generating plant in Weymouth, Mass., to the new Procter & Gamble soap manufacturing company's plant on the other side of Fore River.

Part of the distance is along the surface of the ground, on both sides of the river, and part is through a 700 ft tunnel 7½ ft diameter under the river, constructed to carry two power lines of the Edison Company, one of 13,000 and the other of 24,000 volts. There is a 69 ft drop to enter the tunnel and a similar rise at the farther end on the customer's property.

There are two lines, one carrying steam at 1250 lb and the other at 350 lb, both at a temperature of 750F. The high pressure steam is for processing and the low pressure is used for heating and cafeteria kitchen service.

Contract calls for a maximum of 80,000 lb per hr of 150 lb steam and 16,500 lb per hr of 900 lb steam, both delivered at a point 3300 ft from the Edgar Station.

Since no condensate was to be returned by the customer, it was necessary to provide for a maximum of 96,500 lb per hr of additional make-up water. To treat this make-up water a zeolite feedwater treating system was installed. The treated water is fed only to the 425 lb boilers furnishing the low pressure steam.

Because of the long receiver capacity of such a line, and because close control of pressure and temperature at the station end would be difficult, control equipment is located at the customer's plant, to be operated by Procter & Gamble plant engineers.

Ordinary pressure drop calculations deal with a 5 or 10 lb drop in cases where the total pressure is high enough so that a 50% error would not be serious. But in these lines a 335 lb drop was available for the 1250 lb line and a 200 lb drop for the 365 lb line, with the change of specific volume along the line due to the heat loss through the insulation a substantial factor, so that any error in pressure drop would seriously affect the maximum capacity of the service.

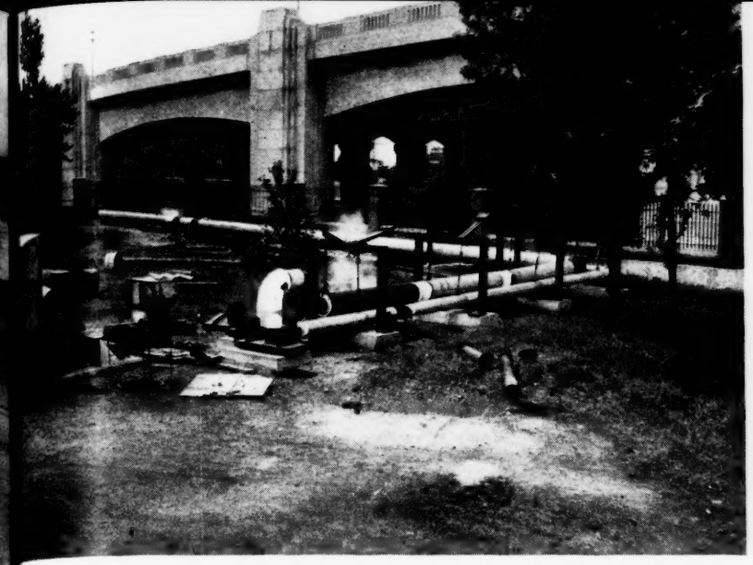
While no difficulty was found in selecting proper formulae for the calculations, choice of the friction factor for the 1,250 lb line gave some concern. However, this was properly covered, while the low pressure line is sized to carry an extra 100,000 lb of steam if necessary.

For this line 14-inch, schedule 40 pipe was used, running 2,200 ft to the far end of the tunnel, and thence by means of 1,000 ft of 8-inch, schedule 40, to the customer's property. A terminal pressure of 220 lb under maximum conditions was indicated. The high pressure line, used entirely for process work, consists of 2,200 ft of 4-inch, schedule 160 pipe, and 1,000 ft of 3-inch, schedule 160, with terminal pressure calculated at 1,060 lb at the maximum flow.

Insulation was made thicker than is ordinarily economical, to ease the control problem, as well as to simplify the pressure drop and the tunnel ventilation. On the line running outdoors, the canvas jacket over the 3½ inches of Philip Carey insulation is weatherproofed and covered with another galvanized metal jacket.

Engineers were much concerned over the problem of protecting the electric lines in the tunnel from the heat that would be liberated from the steam lines. To conserve the heat within the pipes they were heavily insulated with Carey magnesia insulation in the tunnel and fans installed at the far end to exhaust the hot air.

To mechanical minds, and to the workmen on the job, however, the principal problem was not the extreme heat, but how to erect 40 ft lengths of 12 in. pipe, weld and cover them, while almost at their backs were cables carrying a death dealing voltage. All was completed without incident,



Close-up of high pressure steam line on Boston Edison Company's property at the point of entering the 700 ft tunnel. Picture was taken before insulation was complete.

Interior of 700 ft tunnel showing the two high pressure steam lines at the left. Pipes are partially covered with insulation. At the right can be seen high voltage lines.

however, and the result was a beautifully engineered and workmanlike job.

Compensating for Expansion

Certain sections of the line, when heated to 750 F, expand as much as 2 ft. To prevent serious distortion, or failure in the lines, due to sagging, springs were built into them to accommodate this motion. Four expansion loops for the low pressure line and three for the high pressure were employed to care for expansion in the separate sections. Joints and valves were welded.

Where the lines run outdoors, across Edison property to the tunnel, they are supported on spring hangers. Leaving the station above truck clearance, the pipes are carried on a new pipe bridge supported by the towers of the coal belt and then drop down from the coal belt bridge to concrete pyramidal supports, to rest on aluminum cradles. Supports for the long run on the bridge are roller type and can accommodate longitudinal motion up to 14 inches. At the first expansion loop, the pipes are carried down into the coal belt enclosure, here running through a short tunnel to avoid a city highway crossing, the lines being supported from the roof of this tunnel on ball bearings.

On the other side of this roadway the pipes again emerge to the surface and run in a bend, which must absorb the 22 in. motion resulting from expansion in the underwater tunnel farther along. The 69 ft drop also introduces vertical motion into this part of the line, the supports of which are counterbalanced levers with a 5 ft rod to the pipe. The weighted lever accommodates the vertical motion, while a hanger rod is called upon to move a maximum of four inches out of the vertical plane.

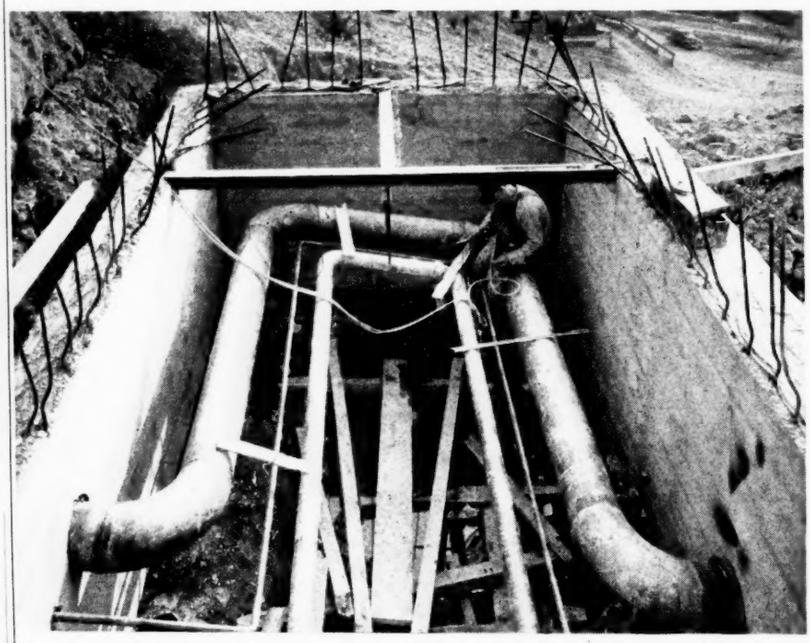
Where the lines drop down into the tunnel shaft they are again supported by counterweighted hangers, with bars 10 ft long, to minimize the effect of angularity. Vertical motion at the tunnel entrance point is 4½ inches and the horizontal is 18 inches. Roller supports are used for the lines within the tunnel, these equipped with guides to limit side way to one inch.

The exit tunnel shaft, also 69 ft deep, ends in the middle of a public street, hence another tunnel of 25 ft carries the lines, now reduced to eight and three inches respectively, to the Procter & Gamble property. There again the run along the surface of the ground, with anchors and hangers at various points until a truck way interferes, at which point they are carried for the remaining distance on a steel trestle into the plant, where a service valve is placed, followed by a pressure reducing valve, de-superheater and meter. At one point in the P&G end of the lines they turn on elbows, with counterweights and levers supporting them. Pitch is generally 1 in. per 100 ft, with drips at all low points. Free blows are provided at certain additional critical points, with impulse traps for both pressures used because of their simplicity, most of them discharging into dry wells, the drip lines being left uncovered to give maximum cooling. Traps in the tunnel normally discharge against the 70 ft gravity head into a dry well.

Tunnel Ventilation

Two exhaust fans, each of 25,000 cfm capacity are installed at the Weymouth end of the tunnel, with provision for a third if found necessary. This is equivalent to a 50-mile gale and requires a 10-inch pressure drop. Air is admitted to the tunnel through a louver house at the opposite end, in Quincy. Provision is made to vary the ventilation relative to outdoor temperature by means of variable inlet openings and one two-speed fan motor. Automatic alarm and shut-off devices are installed to shut off the steam lines if tunnel temperature exceeds 140F. The fans are Buffalo Forge Company's super-limit load type. One fan is constant at 1,750 rpm and the other is a two-speed at 1,750 and 850. One fan has been found sufficient to deliver more than contract volume, close to 40,000 cfm at high and 20,000 cfm at low speed.

TERRACE VILLAGE



(Top) Photo illustrates the great difference in ground levels which caused considerable difficulty to designers of heat distribution system. (Middle) Manhole showing Tube-Turn expansion loops on a 10 in. line serving the entire project with steam. The 4 in. line is the return line while 1½ in. is high pressure trap line. Slip-on flange is used as anchor because of steep grade. (Below) Air view of Terrace Village Project. (Right) Typical pump room showing how welding and Tube-Turn welding fittings made it possible to nest piping very closely.

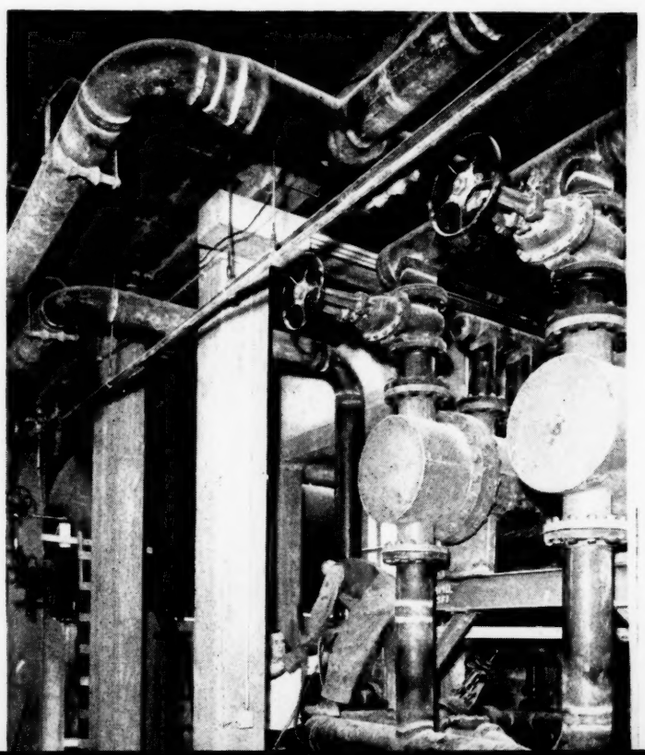
Because of the varying elevations of the site for the Terrace Village Project in Pittsburgh, there were many problems to solve in installing the heating and distribution system.

This housing project is officially known as Terarce Village Unit No. 2 and was erected under the Housing Authority of the City of Pittsburgh. The project is on very high ground and because of its elevation affords a splendid view of the city and the surrounding country. It consists of a total of 83 buildings comprising 1,851 dwelling units, all obtaining heat from a central plant through underground distribution system.

In constructing the project approximately 2½ million cu yd of dirt were moved during the construction. In one instance a cut 75 ft from the top of the hill was moved into the Soho Valley to provide for a playground site. While the site was being graded 25,000 tons of coal were uncovered and stored for future use in the heating plant.

The heating plant is located at the lowest point in the project and contains four 500 hp boilers operating at 125 lb pressure. Steam pipes extend underground to six different hot water generating stations from which forced hot water is circulated to all buildings for heating. Pipes are of steel with welded connections. Over 26,300 ft of RicwiL pre-sealed insulated pipe units were used in the underground distribution system on this project. These units are of pre-fabricated construction using Armo iron conduit, heavy asphalt coated, and with sectional pipe covering.

Each of the hot water generating stations serves approximately 20 buildings. Incorporated in these stations are the necessary pumps for forcing the hot water at approximately 60 lb pressure through the hot water mains. The architects and engineers on this project were Marlier, Lee, Boyd and Prack of Pittsburgh, while the heating contractor was McGinness, Smith and McGinness Company, of Pittsburgh, Pa.



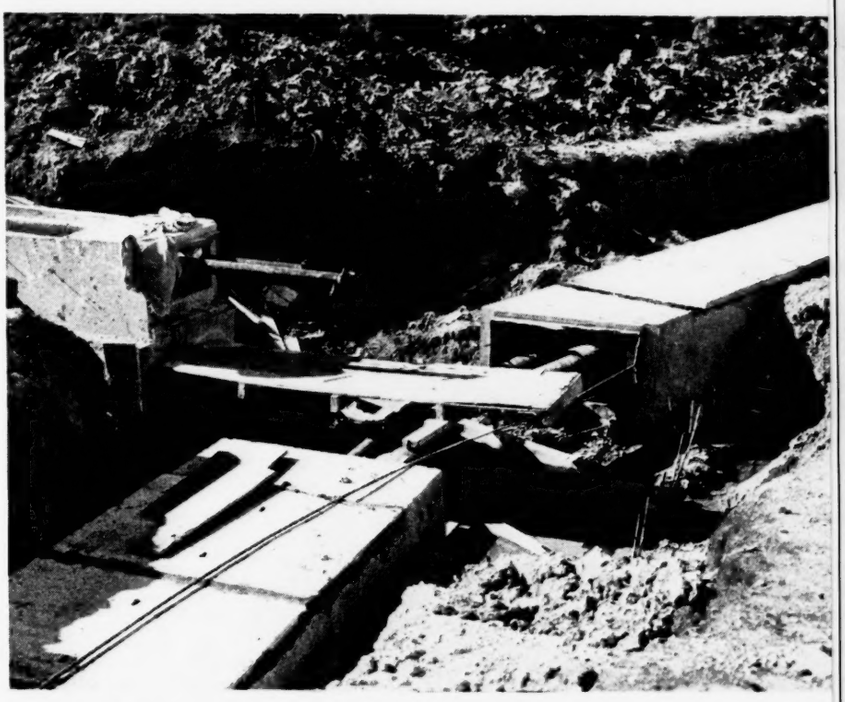
CHANUTE FIELD

The underground steam distribution system which was installed to supply heat to the various buildings at Chanute Field, United States Army Aviation field at Rantoul, Illinois, is of interest at this time because this field is one of the leading air bases in the country; also because of the problems encountered in distributing this steam.

A central heating plant is used to generate all the steam for heating and all steam is distributed by underground pipes carried in concrete conduit. All of the steam lines are insulated with Carey double standard thick 85% magnesia pipe covering to insure delivery of the steam with a minimum loss. In order to maintain an efficiency of covering, a 45 lb roofing jacket securely sealed with asphalt and wired in place with 16 gauge copper wire was used.

Underground steam distribution was necessary in this field since there could be no barriers to interfere with the safe landing and departure of planes. Concrete conduit or trenches are constructed so that the top of the trench sides are rabbeted to hold the trench covers in place. Trench covers are reinforced concrete slabs. Before the covers are put into place bitumastic felt is laid on the lower side of the rabbet and hot bitumastic is poured along the top of the trench wall. Then bitumastic cement is poured over the joint to prevent any surface water from leaking in between the joints and the covers.

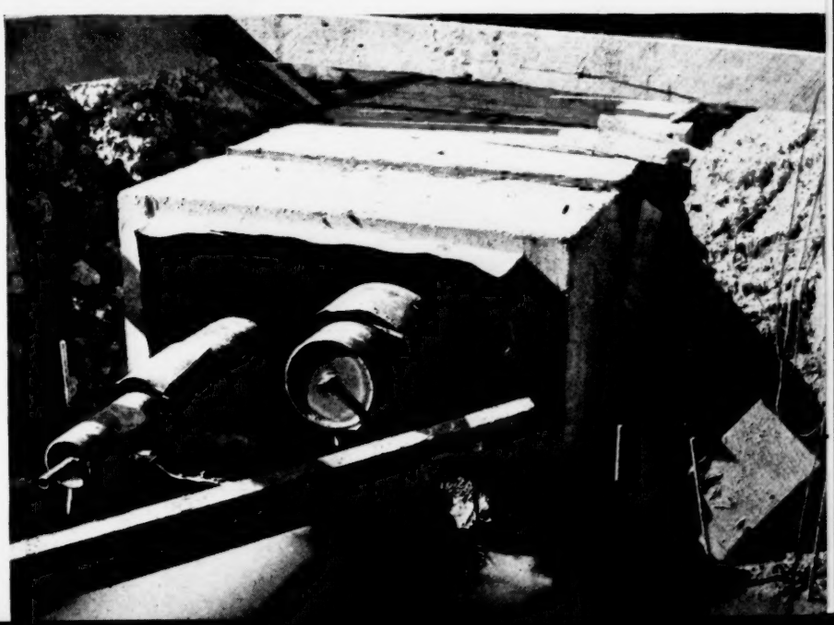
(Above) Main steam conduit which carries steam supply and return to the main school hangar. Note the trench covers which are sealed in place with bitumastic before back filling.



A view of the junction of steam conduit. Conduit at the right leads to warehouses while that at the left supplies heat to the non-commissioned officers quarters.

(Below) Workmen installing Carey double standard thick 85% magnesia sectional pipe covering in one of the underground conduits.

(Below) Close-up of a typical conduit showing supply and return line during installation.



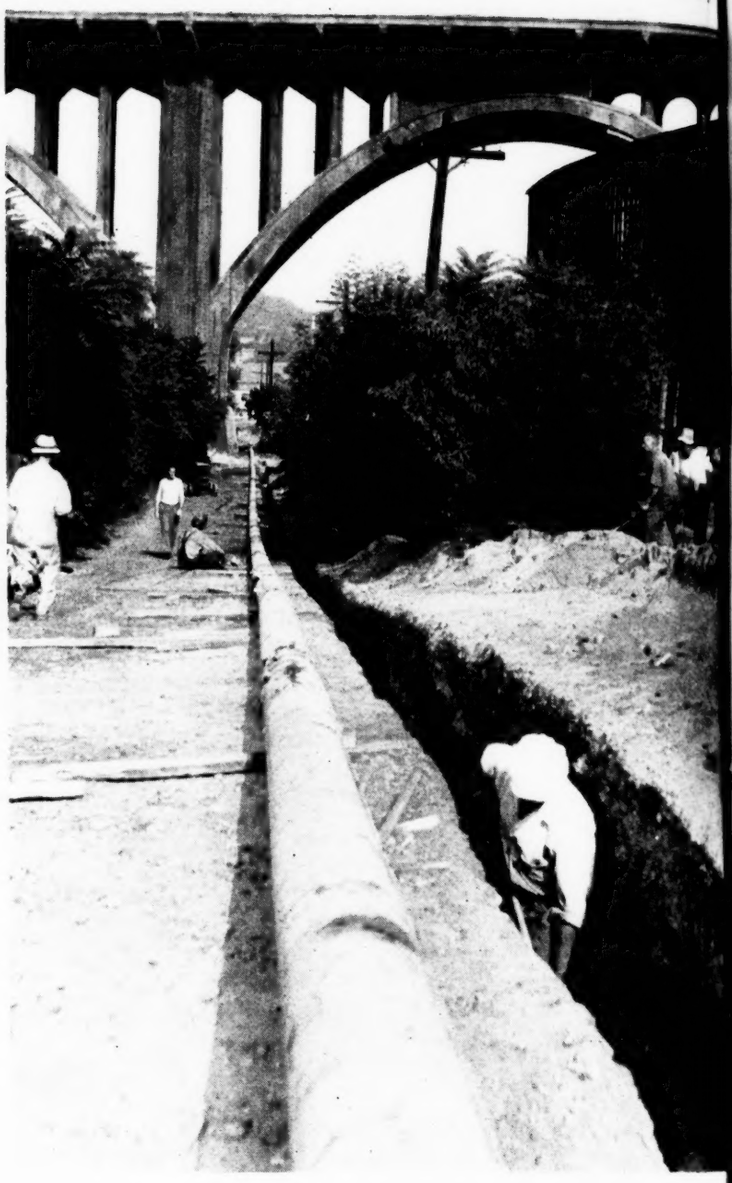
ELIZABETH PARK

The Elizabeth Park Housing Project in Akron, Ohio, was constructed by the Akron Metropolitan Housing Authority on a 15-acre tract of ground in the Little Cuyahoga River Valley.

This project consists of 32 buildings with 276 dwelling units. The heating engineer was Paul B. Fleming of Cleveland while the heating contractor was Scholl Choffin Company of Youngstown, Ohio.

Because of bad weather conditions pre-sealed insulating pipe units were specified for underground pipe distribution. It was felt that this type of construction which required a minimum of field joints to be sealed would eliminate any trouble from water penetration and damage to the insulation.

Approximately 7,000 ft of Ric-wiL pipe units were installed to protect the steam return and hot water lines which ranged from 8 to ¾ in. in size. The pipe is covered with sectional 85% magnesia insulation. In addition to this underground work on the site of the housing project itself about 2,000 ft of similar construction for a 6 in. steam line connecting the project with the City mains of the Ohio Edison Company was installed. An unusual feature of the pipe units was that they were made in extra lengths of 50 ft and also that the connections between the adjacent sections were welded in place. In one instance in placing the steam line the pipe units were welded in a single piece 700 ft long and the pipe dropped into an open trench.



↑ The above illustration shows the welded 700 ft length of pipe ready to be dropped into the open trench to become a link in the steam line serving the Elizabeth Park Housing Project.

← At the left is a view of a workman applying the asphalt blanket to the connector between Ric-wiL pipe units.

A limited number of reprints of this 16-page section on Underground Steam Piping (H & V Reference Section No. 2) available at 25 cents each, from HEATING AND VENTILATING, *148 Lafayette St., New York, N. Y.*

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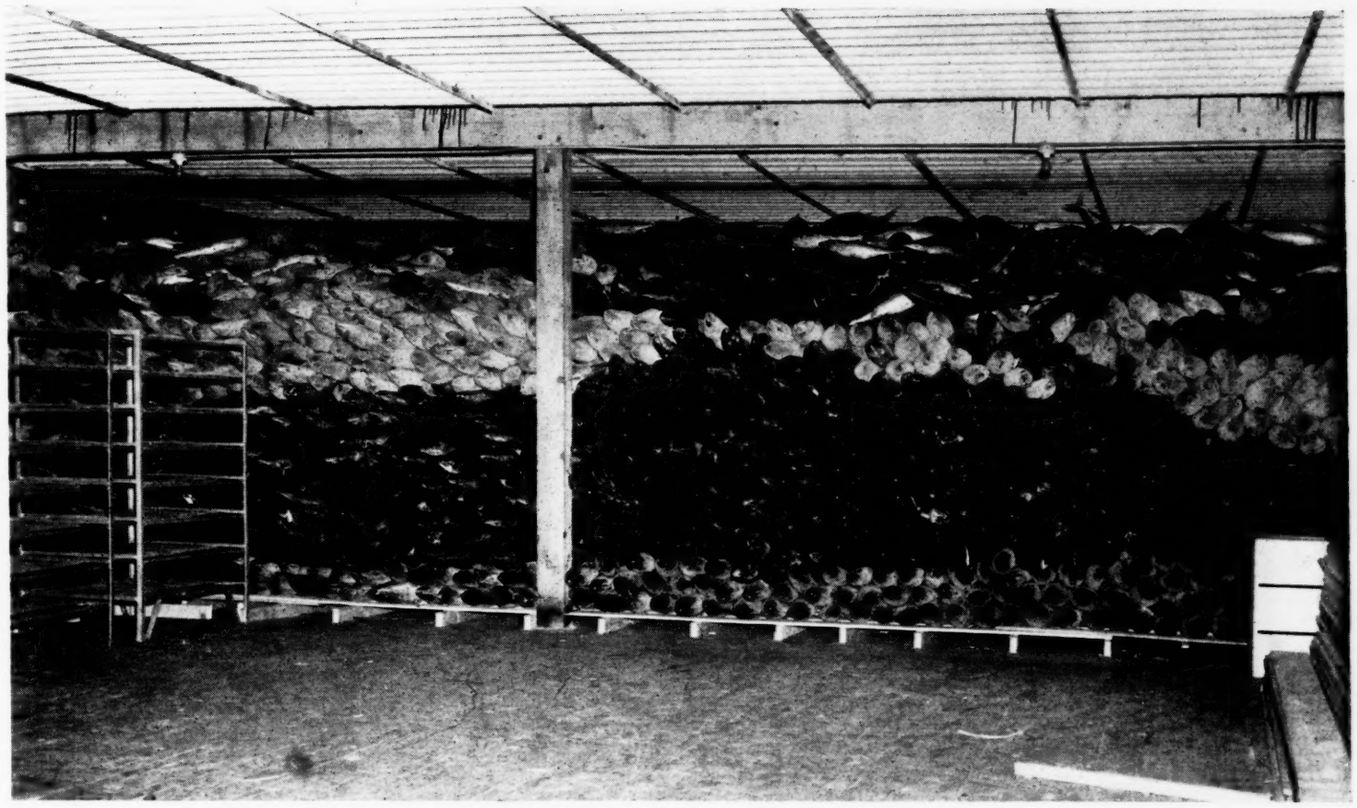


The psychrometric chart described in this article will prove specially useful in solving the problems involved in rooms where low temperatures or low humidities are maintained. One example of such a room is shown above. This is one of the five freezing rooms in the plant of the Columbia River Packers Association, Inc., in Astoria, Oregon, where 145,000 lb of fish are frozen daily.

A New Psychrometric Chart for Low Temperature and Humidities

By C. N. DEVERALL†

Previous psychrometric charts have been almost impossible to use in solving problems involving low temperatures and relative humidities. To overcome the undesirable features of these charts the author has derived this chart in which the scale below zero has been enlarged to three times that of the scale above zero and has many other improvements which make it easier and more accurate than older charts.

ENGINEERS dealing with air conditioning problems involving low temperatures and low humidities have had considerable difficulty in estimating the various air properties particularly when working with air temperatures below 32F and relative humidities below 10%. Most psychrometric charts, if they cover this range at all, have the lines so crowded together that it is impossible to obtain accurate readings in this zone. This is unfortunate since in low temperature and low humidity work the quantities of heat and moisture are small and must be very accurately determined to be of any value at all.

To eliminate these difficulties and to provide information on air conditions in the range from 40F below zero to 50F above zero, the author has prepared the chart shown in reduced form on page 53. On this chart the dry bulb temperatures are represented by vertical lines drawn from the scale at the bottom of the chart while the dewpoint temperatures are represented by horizontal lines projected from a scale at the right hand side of the chart. The scale below zero has been enlarged to three times that of the scale above zero. This is accomplished by increasing the dewpoint temperature scale below zero. The break in the saturation and relative humidity curves and the change in slope of the wet bulb line is due to this increase in scale. It will be seen that the dewpoint divisions below zero are as easily readable as they would be on a conventional chart three times as large.

Another improvement is the folded scales for moisture content (grains per pound of dry air) and total heat. The term *total heat* is not strictly correct as the heat of the liquid is not included. This term, however, has been so long in use that it seemed advisable to continue its use with this explanation. It will be seen that with these scales it will be possible to read grains of moisture to three decimal places and total heat to two decimal places. This is far beyond the accuracy of instruments used outside of laboratories and should be

†Niagara Blower Company, Buffalo, N. Y.

more than accurate enough for all practicable purposes.

Another improvement is the projection of the scales from the master scale at the left hand side of the chart to the directrix curves. This eliminates the troublesome task of following each point determined on the curve through a mass of lines to the scale at the side of the chart. Values for both dry and saturated air are given on the weight and volume scales above zero. Below this point the difference between the two is so small as to be negligible.

Barometric Correction

Most existing charts are based on values at 29.92 in. Hg. barometric pressure. In most cases the error arising from the variation in barometer will be small and may be disregarded. The fact remains, however, that any great variation in total pressure due to barometer or in apparatus operated at pressures above or below atmospheric pressure will affect the various values. This is particularly true in the low temperature range. It was therefore thought advisable to provide means for barometric correction.

A scale of wet bulb slopes at various barometric pressures will be found to the left of the saturation curve. These lines are plotted in 1 in. variations from plus 2 in. above to minus 7 in. below 29.92 in. Hg. The angle that these lines form in relation to the horizontal dewpoint lines is determined from basic data as was the slope of the wet bulb lines plotted on the chart for the 29.92 value. By projecting these lines parallel to this scale from the intersection of the desired wet bulb and the saturation curve, the wet bulb lines for the desired barometric pressure may be drawn—and the dewpoint at the corrected barometer determined.

As the moisture content, total heat, weight and volume scales are based on air density at 29.92 in. Hg., they must be corrected for other barometric pressures.

To find the proper correction for grains of moisture and total heat values a table of Additive Corrections is provided. Additions to or deductions from standard values for various saturation temperatures at various barometric pressures are tabulated. The approximate altitudes corresponding to the various barometric pressures are also given. See Table 1, page 55.

The moisture content of air at constant dry bulb temperatures varies inversely as the ratio of the barometric pressure, hence the correction for moisture content. This increase or decrease in the moisture content affects the total heat to the extent of the heat contained in this moisture, hence the correction for total heat.

Relative humidity curves are provided for the determination of approximate relative humidities. For accurate determination of this value, however, the following simple formula should be used:

$$\frac{\text{Grains of Moisture Per Lb. at Dewpoint}}{\text{Grains of Moisture Per Lb. at Saturation}} = \text{R.H.}\%$$

or

$$\frac{\text{Vapor Presssure at Dewpoint}}{\text{Vapor Pressure at Saturation}} = \text{R.H.}\%$$

In correcting weight per cubic foot for barometric pressures other than 29.92, it will be sufficiently accurate for the purpose of this chart to use the following formula:

$$W' = \frac{W \times b'}{29.92}$$

wherein

W' = Weight of air at corrected barometer.
W = Weight of air at 29.92 in. Hg.
b' = Corrected barometric pressure—Inches Hg.

This formula is for dry air, and as it does not take into consideration correction for vapor in the mixture, it is not strictly correct for saturated or partially saturated air. At temperatures within the range of this chart, however, the error would be found in the fourth or fifth decimal place. As this is far beyond the accuracy required in the average problem, it is not necessary to complicate this calculation with elaborate formula. Where absolute accuracy is required, basic formula should be used.

Use of Chart

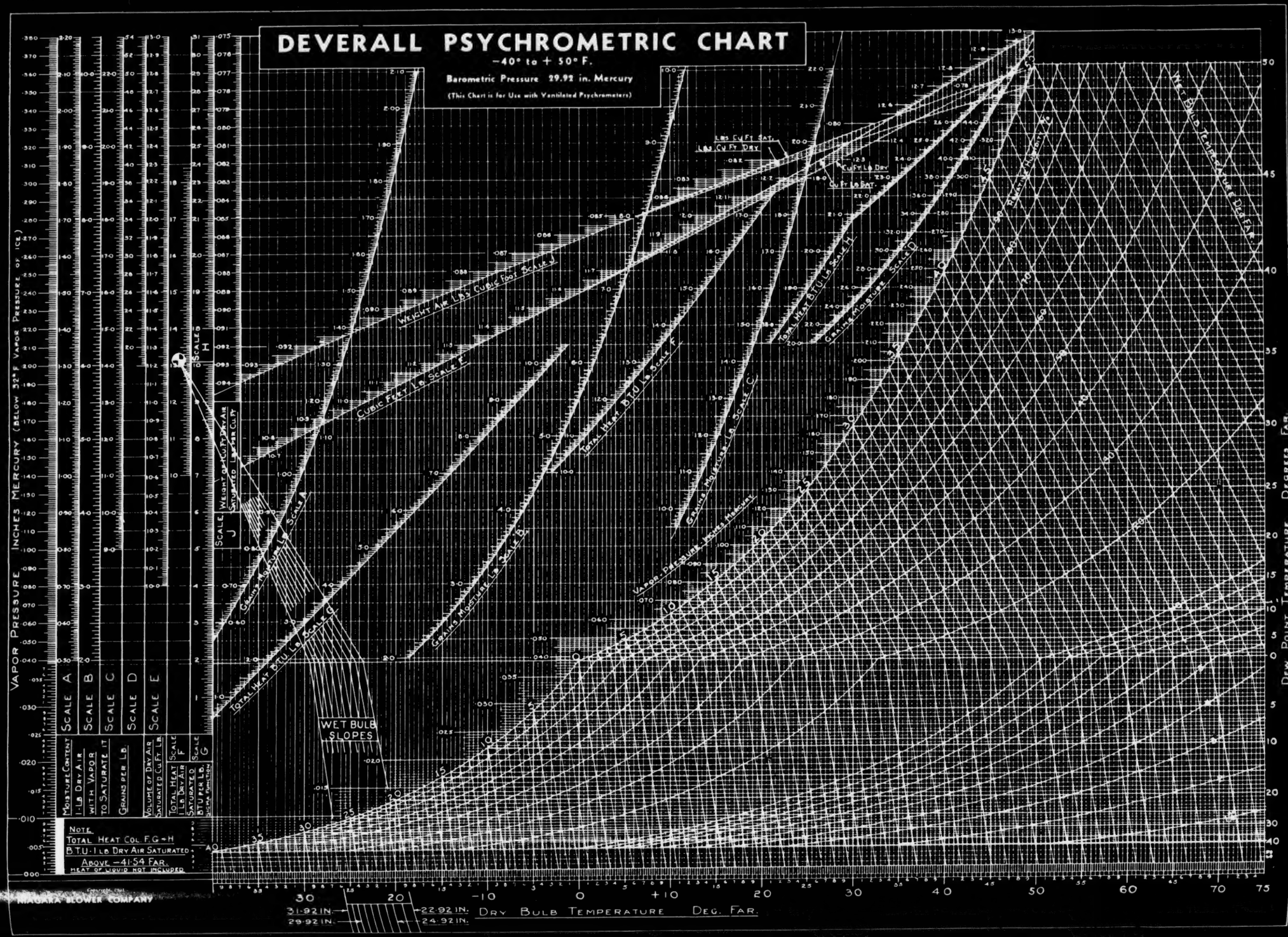
There is nothing complicated about the use of this chart. The procedure is essentially the same as in the use of existing charts. It is suggested that the user familiarize himself with the various scales and then work through the examples given, checking his results with those given. Whether or not the barometric variations should be taken into consideration would depend entirely on the amount of variation there would be from the standard condition of 29.92 in. and the accuracy at which the determination must be made.

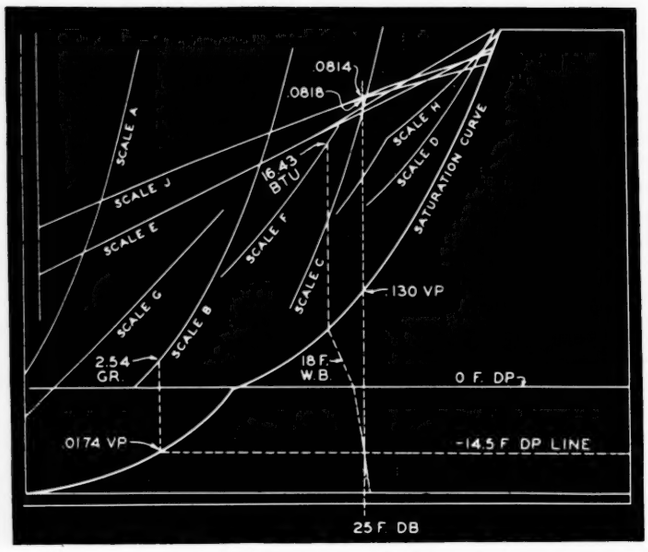
It is suggested that in making the wet bulb corrections on the chart the wet bulb slope for the barometer to be used be traced over the *wet bulb slope scale* on a piece of tracing paper with the zero dewpoint line drawn through as a datum line. This tracing can then be slid over the chart, keeping this zero datum line over the zero dewpoint line on the chart, moving the tracing so that the *wet bulb slope line* will intersect the point desired.

Accurate Wet Bulb Readings

As the practical use of the chart and the value of the determinations made on it depend so much on the accuracy of the wet and dry bulb readings, it would be well to point out that at low temperatures the wet and dry bulb readings must be made very accurately. A matter of a fraction of a degree in the determination of these temperatures will make a very great difference in the determination of dewpoint as made on the chart. Several successive readings should be taken and their results compared.

The reading of a wet bulb thermometer in a low temperature room requires patience and considerable skill. The temperature of the wet wick will quickly drop to several degrees below + 32F. The wick will then freeze and the temperature rise to + 32F during the freezing period. The frozen wick will then be subcooled to the final wet bulb temperature. As the temperature approaches the lowest point, the drop will be very slow and very close observation must be made to determine this lowest point which is the wet bulb temperature. The operator should be warmly dressed so that he may, without physical discomfort, stay in the


DEVERALL PSYCHROMETRIC CHART
-40° to + 50° F.
Barometric Pressure 29.92 in. Mercury
(This Chart is for Use with Ventilated Psychrometers)
VAPOR PRESSURE INCHES MERCURY (BELOW 32° F VAPOR PRESSURE OF ICE)
DEW POINT TEMPERATURE DEGREES FAR.
WET BULB TEMPERATURE DEG FAR.
DRY BULB TEMPERATURE DEG. FAR.
SCALE A
SCALE B
SCALE C
SCALE D
SCALE E
SCALE F
SCALE G
SCALE H
SCALE J
MOISTURE CONTENT 1 LB DRY AIR WITH VAPOR TO SATURATE IT GRAINS PER LB.
VOLUME OF DRY AIR SATURATED CU FT. LB.
TOTAL HEAT 1 LB DRY AIR SATURATED BTU PER LB. DRY AIR
WEIGHT OF CU FT DRY AIR SATURATED LBS PER CU FT
WEIGHT AIR LBS CUBIC FOOT SCALE J
CUBIC FEET 1 LB SCALE I
GRAINS MOISTURE SCALE A
GRAINS MOISTURE LB SCALE B
TOTAL HEAT BTU LB SCALE C
TOTAL HEAT B T U LBS SCALE F
GRAINS MOISTURE LB SCALE CC
TOTAL HEAT BTU LB SCALE D
GRAINS MOISTURE SCALE D
VAPOR PRESSURE INCHES MERCURY
WET BULB SLOPES
LBS CU FT SAT.
LBS CU FT DRY
CU FT LB DRY
CU FT LB SAT.
NOTE
TOTAL HEAT COL. F.G.-H
B.T.U.-1 LB DRY AIR SATURATED
ABOVE -41.54 FAR.
HEAT OF LIQUID NOT INCLUDED
31.92 IN.
29.92 IN.
22.92 IN.
24.92 IN.
MADE BY
NIAGARA BLOWER COMPANY



Example 1. Skeleton diagram of Deverall psychrometric chart showing the solution to example 1.

room for as long a time as it takes to make an accurate reading. *Unless the reading is absolutely accurate, it is without value.* For example, ½F inaccuracy in the reading of the 18F W.B. temperature used in the examples would make a difference of 8F to 10F in dewpoint.

The thermometers used must, of course, be of highest accuracy with scales long enough so that graduations may be read to 1/10 of 1 degree.

Example 1: Assume a condition of + 25F dry bulb, + 18F wet bulb at 29.92 in. barometer. Determine the following:

Dewpoint
Grains of Moisture per pound
Total heat
Vapor pressure
Relative humidity, weight per cubic foot at D.P. and weight per cubic foot of the mixture.

Dewpoint:

At intersection of + 25F dry bulb and + 18F wet bulb line, read dewpoint — 74.5F.

To Determine Grains of Moisture:

From intersection of — 14.5F dewpoint and saturation curve, follow — 14.5 dry bulb line vertically to its intersection with curve scale B and read 2.54 grains per pound.

Total Heat:

This is a function of the wet bulb and is read at the intersection of the + 18F vertical line and curve scale F as 16.43 B.t.u. per pound.

Vapor Pressure:

This is read on the vapor pressure scale which is plotted adjacent to the saturation curve. Vapor pressure at + 25F equals 0.130. Vapor pressure at dewpoint — 14.5 is 0.0174.

$$\text{Relative Humidity} = \frac{\text{Vapor Pres. at Dewpoint } .0174}{\text{Vapor Pres. at Saturation } .130} = 13.4\% \text{ R H.}$$

Weight at dewpoint — air at + 25F dry bulb + 18F wet bulb is saturated at — 14.5F dewpoint. Follow vertical —14.5 line to intersection with curve J and read weight per cubic foot .0893 lb. Saturated at — 14.5F.

The weight of the mixture is read at the intersection of the dry bulb lines and curve scale J. It will be noted that values for both dry and saturated air are given above zero, the weight of saturated and dry air being read on upper and lower scale J curves. For partially saturated air, the difference between the two is apportioned according to the percent relative humidity of the partially saturated mixture. For example, in this problem where the dry bulb temperature is + 25F, the wet bulb temperature is + 18F, the dewpoint has been determined as — 14.5F and the relative humidity 13.4%. Follow the vertical + 25F line to its intersection with curve J. On the lower scale J read the weight of dry air as 0.0818, and on the upper scale J the weight of saturated air as 0.0814. 0.0818 — 0.0814 = 0.0004 × 13.4% = 0.000053. 0.0818 — 0.00005 = 0.08175 weight of air at + 25F dry bulb partially saturated at 13.5% R.H.

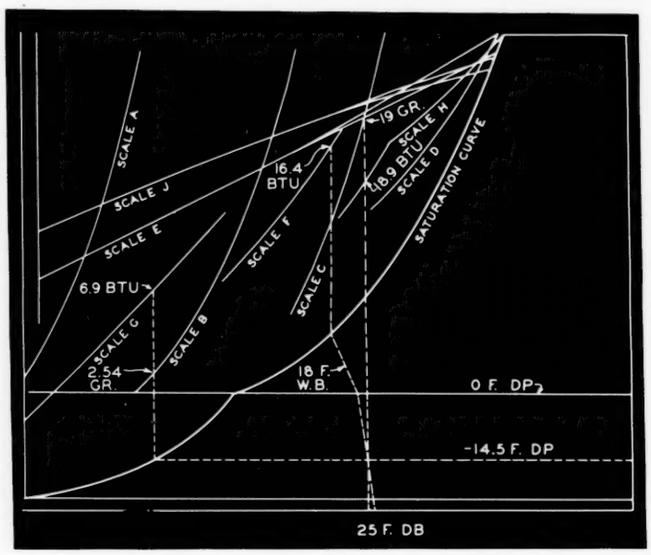
In the lower temperature range (below zero degrees) where separate values are not given for dry and saturated air, the weight of both dry saturated and partially saturated air is read from the single scale. The error, however, is so small in this range as to be negligible.

Example 2: Assume that + 25F saturated air is to be brought to the condition in the last example, that is: + 25F Dry Bulb, 13.4% Relative Humidity.

The procedure would be to cool the air, reducing the moisture content to that required in the final condition. If the air were cooled to — 14.5F saturated, then reheated back to + 25F at a constant dewpoint of — 14.5F, that is without adding moisture, the final condition would be + 25F dry bulb, — 14.5F dewpoint, which would produce 13.4% rel. hum. and + 18F wet bulb.

To determine the amount of heat and moisture removed in the above process, the chart may be used:

First: Determine the values for + 25F saturated air. Follow the vertical + 25F line to its intersection with curve C and read 19 grains per lb. which is the moisture content of air saturated at + 25F. Follow



Example 2. Skeleton diagram of Deverall psychrometric chart showing the solution to example 2.

TABLE 1.—ADDITIVE CORRECTIONS

(Grains Moisture and Btu Lb Air at Various Barometric Pressures)

	Barometer— Inches, Hg.											
	30.92		28.92		27.92		26.92		25.92		24.92	
	Altitude, Feet											
	— 900		+ 900		+ 1800		+ 2700		+ 3800		+ 4800	
Temperature	Gr	Btu	Gr	Btu	Gr	Btu	Gr	Btu	Gr	Btu	Gr	Btu
40	— .018	— .003	.019	.003	.039	.006	.061	.009	.085	.012	.111	.016
35	— .024	— .004	.026	.004	.054	.008	.085	.013	.117	.018	.152	.028
30	— .033	— .005	.035	.005	.073	.009	.113	.017	.157	.024	.205	.030
25	— .045	— .007	.047	.007	.098	.018	.153	.023	.212	.032	.276	.041
20	— .059	— .008	.063	.009	.131	.020	.205	.031	.284	.043	.368	.055
15	— .079	— .012	.084	.013	.174	.026	.272	.041	.376	.056	.491	.074
10	— .104	— .016	.111	.017	.232	.034	.358	.054	.498	.074	.646	.097
5	— .136	— .020	.146	.022	.302	.046	.472	.071	.650	.098	.848	.128
0	— .178	— .026	.190	.029	.395	.059	.613	.093	.850	.128	1.105	.167
5	— .230	— .035	.246	.037	.512	.078	.794	.120	1.100	.167	1.430	.217
10	— .30	— .04	.32	.05	.66	.10	1.03	.16	1.42	.22	1.85	.28
15	— .38	— .06	.41	.06	.85	.13	1.31	.20	1.82	.28	2.39	.36
20	— .49	— .07	.52	.08	1.08	.16	1.68	.26	2.33	.36	3.05	.46
25	— .62	— .09	.66	.10	1.37	.21	2.13	.32	2.96	.45	3.84	.59
30	— .78	— .12	.84	.13	1.73	.26	2.70	.41	3.74	.57	4.86	.74
35	— .97	— .15	1.03	.16	2.15	.33	3.35	.51	4.63	.71	6.01	.92
40	— 1.18	— .18	1.27	.19	2.63	.40	4.10	.63	5.65	.87	7.38	1.13
45	— 1.44	— .22	1.54	.24	3.18	.49	4.96	.76	6.88	1.05	8.96	1.38
50	— 1.75	— .27	1.87	.29	3.85	.60	6.02	.93	8.36	1.29	10.88	1.68

this same line to its intersection with curve H and read 18.9 B.t.u. per pound, which is the total heat in the air at + 25F saturated. *Next:*—Determine the values for air at — 14.5F saturated, follow the — 14.5F line vertically to its intersection with curve B and read 2.5 grains per pound which is the moisture content at — 14.5F saturated. Follow the same line to its intersection with curve G and read 6.9 B.t.u. per pound which is the total heat in the air at — 14.5 saturated. Tabulating these values:

	Moisture Content	Total Heat
+ 25F Saturated —	19.0 grains/lb.	18.9 B.t.u./lb.
— 14.5F Saturated —	2.5 grains/lb.	6.9 B.t.u./lb.
	16.5 grains of moisture removed.	12.0 B.t.u. removed.

To re-heat this air to + 25F dry bulb without adding moisture would, of course, require the addition of heat. 25 plus 14.5 = 39.5F temperature rise. 39.5F × 0.2415 (approximate specific heat of air) = 9.53 B.t.u. per lb., which is the amount of heat that would have to be added to a pound of air to heat it 39.5F from — 14.5 to + 25F at constant dewpoint. As previously determined, air at — 14.5F contains 6.9 B.t.u. per pound. To this add 9.53 B.t.u. per lb. = 6.9 plus 9.53 = 16.43 B.t.u. per pound which is the total heat contained in 1 lb. — 14.5 saturated air re-heated at constant dewpoint through a rise of 39.5F to + 25F D. B. As total heat is a function of the wet bulb, this value may be read from the chart directly without going through this calculation. At intersection of + 25F dry bulb and — 14.5F dewpoint, read + 18F wet bulb. From the intersection of the + 18F wet bulb line and the saturation curve, follow the 18F line vertically to its intersection with curve F and read 16.43 total heat, which checks with the above calculation.

Check the relative humidity by moisture content:

$$\frac{\text{Moisture Content at } -14.5\text{F}}{\text{Moisture Content at } +25\text{F}} = \frac{2.54 \text{ grains}}{19.0 \text{ grains}} = 13.4\% \text{ R.H.}$$

Note that this checks with the value arrived at in the previous example. It will be noted that this time the grains of moisture formula has been used whereas in the previous calculation the vapor pressure formula was used.

It will be seen from this example that the refrigeration required to cool the air, the heat required to reheat the air, the amount of moisture removed and the final condition of the air may be determined from the Chart.

(A 20 in. x 26 in. copy of this chart together with an explanation of its use is available from the author at the Niagara Blower Company, 673 Ontario Street, Buffalo, N. Y., for the nominal charge of 50 cents.)

Factors Influencing Air Freshness

Much attention has been given to the causes of air freshness in buildings during the last few years. In a recent paper in the *British Journal of Hygiene*, Drs. Bedford and Warner of the British Industrial Health Research Board discussed the environmental conditions in relation to the subjective impressions of freshness.

The study was made in a number of British factories in which the observers independently recorded their impressions as to the freshness or stagnation of the atmosphere and then made measurements of the atmospheric conditions. They concluded that in order to have a fresh and invigorating environment the room should be as cool as is compatible with comfort, since freshness tends to increase as the temperature is reduced. There should also be an adequate air movement, above 20 ft. per min. during the winter or velocities much higher than this during the summer or in hot factories. It is also important that the air movement should be variable rather than uniform and monotonous. Relative humidity of air should be kept reasonably low and the average temperature of the walls and other surroundings should not be appreciably lower than that of the air and should be, if possible, of higher temperature.

ABSTRACTS of Current Papers, Books and Pamphlets

Temperature Measurement

Instruments for the measurement and control of temperatures are the basic tools of the heating and air conditioning profession. While the average engineer uses in his daily work many methods of temperature measurement and control he has only a slight knowledge of the fundamentals of temperature measuring. In many cases this knowledge is sufficient to solve ordinary problems encountered in his daily work and it is only when something unusual comes up that he feels the need for further knowledge. For those engineers, and for engineers specializing in design, installation, or sales of temperature measuring and control devices this book should be of considerable interest.

The book was written to serve as a textbook for college students and outlines a course of study which is essentially practical in nature. The author states that the purpose of the book is to outline an experimental study of the methods of temperature measurement and to give the theoretical principles necessary for their appreciation, intelligent use and extension.

The theoretical principle of temperature measurement is presented in Part I. In this section is taken up methods of measuring temperature, as for example, by expansion, by thermo-electricity, by radiation, and by resistance. Also discussed in this section are the principles of heat transfer and radiation, elementary thermodynamics, as well as calorimetry, special methods of temperature measurement, extreme temperatures and the International temperature scale.

Part II outlines a series of experiments to be conducted in the laboratories to illustrate the principles involved in temperature measurement.

Part III is an appendix and contains tables of physical constants, temperature conversion data, thermocouple data and similar information.

[*"Temperature Measurement," by Robert L. Weber. Published by the Edwards Brothers, Inc., Ann Arbor, Michigan. Heavy paper cover; 8½ x 11 in.; approximately 180 pages. Copies available from the W. B. Keeler Bookstore, Cathaum Bldg., State College, Pa., or the author at the Department of Physics, Pennsylvania State College, State College, Pa. Price, $2.50.*]

BRIEF REVIEWS

Radiant Heating. Reprint of the 32-page radiant heating section which appeared in the March, 1941, issue of Heating and Ventilating. Includes information on design, construction, and installation. Also lists and describes all known radiant heating installations in the United States. [*"Radiant Heating, Reference Section No. 1," by Joseph F. Kern, Jr., associate editor,* Heating and Ventilating, *and F. W. Hutchinson, instructor, department of mechanical engineering, University of California. Paper cover; 9 x 12; 32 pages. Price, 25 cents. Available from* Heating and Ventilating, *148 Lafayette St., New York, N. Y.*]

Water. A discussion of urban domestic water consumption giving information on per capita consumption of water and also some data on the quantities of water used by various plumbing fixtures. Includes some information on domestic water consumption in housing projects. [*"Urban Water Consumption," by M. A. Pond. Published in the Journal of the American Water Works Association, 22 E. 40th St., New York, N. Y., December 1939. Pages 2003 to 2014. Copies available from the American Water Works Association.*]

Mathematics. An advanced book on the application of mathematics to the solution of engineering problems. The author points out that many engineers do not use mathematics in the solution of problems as much as they could not because of a need for more mathematics but because of a need for a better understanding of the potentialities of its application. The method of treatment in this book is to show representative groups of engineering problems and to demonstrate the approach to their solution. Mathematical prerequisites for understanding this book are ordinary calculus, the elements of analytical geometry, the elements of algebra and some knowledge of algebraic equations. [*"Mathematical Methods in Engineering," by T. v. Karman and M. A. Biot. Published by McGraw-Hill Book Company, Inc., 330 West 42nd St., New York, N. Y. Cloth bound; 6 x 9 in.; 505 pages. Price, $4.*]

Fan Noises. A booklet written in non-technical language on the subject of sound levels and other related factors governing selection of axial flow fan units. Purpose is to give fan buyers a better understanding of the features governing proper fan selection for specific sound level limits. Methods of rating noise levels in decibels, comparison of various sound reference levels, influence of fan tip speeds and effect of distance on noise readings are among some of the interesting points discussed in this booklet. [*"A Round Table Discussion on Sound Levels and Fan Selection," by E. O. Martinson. Published by DeBothezat Ventilating Equipment Div., American Machine and Metals, Inc., East Moline, Ill. Paper cover; 8½ x 11 in.; 12 pages. Available upon request to American Machine and Metals, Inc.*]

Industrial Hazards. A general educational bulletin which discusses the health hazards of various occupational environments. Includes information on sanitation facilities, ventilation, illumination, industrial dusts, industrial solvents, industrial gases, and poisoning by metals. Also contains brief summary of the functions of the Division of Industrial Hygiene, Illinois State Department of Public Health. [*"Health Hazards of Occupational Environments, Educational Health circular No. 154." Published by the Department of Public Health, State of Illinois, Springfield, Ill. Paper cover; 6 x 9 in.; 45 pages. Available on request to the Department of Health.*]

NEWS OF THE MONTH

Johnson Summarizes Laboratory Findings on Chimney Draft at Fourth Annual Anthracite Conference at Lehigh

BETHLEHEM, PA.—With coal operators, engineers, retail merchants, stoker and equipment manufacturers as well as representatives of industrial companies in attendance in the auditorium of Packard Laboratory, Lehigh University, Prof. Howard Eckfeldt on May 8 officially opened the Fourth Annual Anthracite Conference. After an address of welcome by Dr. C. C. Williams, president of Lehigh University and honorary chairman of the conference, the first session was turned over to Chairman Paul B. Eaton, Professor of Mechanical Engineering, Lafayette College.

According to W. M. Myers, Professor of Mineral Economics and Technology, The Pennsylvania State College, in his opening paper on "The Importance of Mineral Industries to the Commonwealth of Pennsylvania," the minerals produced in Pennsylvania in a typical year such as 1937 were valued at twice that of all its agricultural products, with coal accounting for 92% of its mineral wealth. Edgar O. Marty, chief mechanical and electrical engineer of the Pennsylvania Turnpike Commission, outlined the uses of anthracite on the Pennsylvania Turnpike. He, in turn, was followed by E. D. Turnbull, chief mechanical engineer, Euston Lead Company, Scranton, Penna., who gave his company's experiences with anthracite in manufacturing white lead.

The second session covered "Practical Pointers in the Installation of Domestic Stokers," by Joseph K. Goundie, Fritch Coal Company, Bethlehem, and "Practical Merchandising of Anthracite from the Dealers' Viewpoint," by Carl A. Fraser, president of Carl A. Fraser, Inc., Albany. The third session, under the chairmanship of E. G. Bailey, vice-president of Babcock & Wilcox Company, covered "Trends in Boiler and Furnace Design to Give Greater Efficiency with Anthracite" and "Observations on the Use of Anthracite in Foundry Cupolas," by M. A. Young, general manager of the Catskill Metal Works, Catskill, N. Y., and J. F. K. Brown, assistant general manager of engineering, Hudson Coal Company. J. D. Jillson, Anthracite Industries, Inc., discussed the changes that were taking place in the domestic fuel market under the fast approaching wartime economies while Frank C. Wright, Jr., vice-president of the Philadelphia & Reading Coal & Iron Company, closed the day's forum with a paper suggesting future research for the anthracite industry.

On May 9 the morning session was under the chairmanship of C. A. Gibbons, general manager of Susquehanna Collieries Company. Papers included "Anthracite Fuel Beds in Water Gas Manufacture," by C. C. Wright, Associate Professor of Fuel Technology, The Pennsylvania State College. Dr. H. J. Rose, Anthracite Fellowship, Mellon Institute of Industrial Research, Pittsburgh, outlined highlights of the fellowship's research in anthracite ash from the standpoint of removal and storage, as well as commercial uses for this by-product. Dr. Rose was followed by Hugh L. Campbell, Jr., Hazleton Brick Company, Hazleton, who described the experiences of his company in using anthracite in the manufacture of its product.

Allen J. Johnson, director of the Anthracite Industries Laboratory, closed the morning session with a paper outlining the findings of the laboratory in its study of draft and draft regulation. Mr. Johnson showed how draft is definitely linked with acceleration, output, efficiency, economy, banking, clinker, interference and the amount of attention required by a heating system, and pointed out how improved results in the operation of heating systems can be obtained, in a vast majority of cases, by means of improved draft control. This improved draft control provides a key to the solution of many problems in connection with combustion that have heretofore not been associated with the question of draft. The draft throttle, a development of the laboratory, was thoroughly described, particularly from a performance angle based on actual field case histories.

After luncheon at the Lehigh Armory, Caleb Kenny, general sales manager of Weston Dodson Company, presided at the closing session. This session included "Factors Affecting Human Comfort in Addition to Temperature," by Prof. C. P. Yaglou, Harvard School of Public Health, Boston, and "Activated Carbon from Anthracite," by Prof. Eric Sinkinson of Lehigh University, Bethlehem. R. C. Johnson, anthracite fellowship, Mellon Institute of Industrial Research, described in detail tests undertaken by the fellowship on service hot water.

Half Space Sold for H&V Show

NEW YORK—With the Exposition eight months away, nearly 200 manufacturers have taken half the space available at the Seventh International Heating and Ventilating Exposition, to be held January 26-30, 1942, in the Commercial Museum at Philadelphia.

Segeler Discusses Heat Gain

CHICAGO—One of the principal features of the American Gas Association Hotel, Restaurant & Commercial Sales Conference held here April 24-25 was a paper presented by C. George Segeler, engineer of utilization of that Association, on "Is There Excess Heat In Restaurants?—An Analysis of Recent Studies."

After reviewing psychrometric tests made in 18 sets of comparable gas and electric kitchens of various types scattered throughout the country, Mr. Segeler concluded that the gas kitchen may actually be cooler and dryer than an equivalent electric kitchen. It was pointed out by the speaker that this condition may result from, among other factors, the better ventilation achieved in the gas kitchen by the flue connection of gas appliances.

Mr. Segeler is reported as making further studies on this subject which will result in a bulletin which will later be issued by the American Gas Association.

Building Cost Index Steady

NEW YORK—The national average of the construction cost index of The American Appraisal Company increased one point and stood at 213 for April in comparison with 212 for the prior months since November, 1940. The increase in the index was due to an uptrend in labor rates which was offset in part by a slight reduction in some lumber prices. Lumber prices, after an almost unbroken increase from September to December, 1940, leveled off from January to March and showed a few small decreases for some grades in April. The construction labor index increased from 251 to 254 in April, or a 10-point increase over the labor index of 244 in April, 1940.

Army Homes Ready by July 4

WASHINGTON—An Army housing program for non-commissioned officers and civilian workers providing shelter for more than 10,000 families will be completed by July 4, Secretary Stimson reported May 15.

The housing, generally adjacent to training areas, will cost about $3500 per family and take care of the families of 8000 sergeants and about 2000 civilian workers. For rent the sergeants will pay the government their rental allowance; civilian workers will pay one-fifth of their monthly income.

C. F. Palmer, coordinator of the defense housing program, reported awarding of contracts for 2793 dwelling units during the week ended May 10.

Buffalo Needs Air Conditioning, Davis Tells A.C. Council

BUFFALO—The air conditioning industry in Western New York and in the rest of the country must stop selling equipment and start selling air conditioning as a service, Walter P. Davis, executive secretary of the Air Conditioning Council of Western New York, told Council members at the final Council meeting of the season.

Mr. Davis spoke at a round table discussion of problems in the industry which witnessed a lively and highly enlightening exchange of ideas by leaders in the industry in this area. "You fellows might as well make up your minds now that the public is not interested in types of equipment," Mr. Davis said. "They are interested only in results in terms of increased business and profits based on comfort which air conditioning affords."

Mr. Davis opened his discussion by pointing out that the Air Conditioning Council was formed primarily to promote the idea of air conditioning rather than to serve as a medium of exchange of technical data. "Yet," he declared, "there are only a handful of our members who have direct contact with the public. These contractors today are making sales not on the basis of air conditioning comforts, but on the basis of equipment. The rest of our 60 members sell equipment to the contractors and seldom if ever have any contact with the public."

Therefore, Mr. Davis said, actual sales efforts here on air conditioning are very limited. "And from talks with Council representatives in other parts of the country, I find this situation also prevails in most other sections," he added.

"You members need to get together and co-operate with the Council so it can advise the buying public. The way things are running now, we are really taking in each other's washing."

Stressing the fact that the air conditioning industry has not had enough promotion work, Mr. Davis said, "we will miss the boat if we continue to sell equipment instead of the service."

For several years now, he said, big merchandisers in Buffalo have been modernizing their stores to attract new business and yet many of these modernized establishments are without air conditioning.

"Merchants have been led to believe that Buffalo is the coolest city east of the Rockies. Some merchants here say Buffalo needs air conditioning only 11 days of the year. Chain stores here receive outside weather reports showing that Buffalo has a comparatively low temperature during the Summer.

"But these merchants do not realize that Buffalo's weather report readings are made 243 feet above the street, facing Lake Erie.

Tasker Heads Toronto Chapter

TORONTO—New officers installed by the Ontario chapter of the ASHVE at the recent annual meeting in the Royal York Hotel here, were as follows: Cyril Tasker, president; Douglas O. Price, General Steel Wares, Ltd., vice-president; Harry R. Roth, Canadian Sirocco Co., Ltd., secretary-treasurer. The board of governors will be composed of Ernest R. Gauley, editorial staff of *Sanitary Engineer;* W. C. Kelly, Iron Fireman Mfg. Co., Ltd.; and Arthur S. Morgan, Fess Oil Burners of Canada, Ltd.

The winning thesis for the chapter's annual award to third or fourth year students in the Applied Science classes at Toronto University was written by D. L. Angus. Mr. Angus' paper was on "Heating Buildings with Unit Heaters."

Coulee Dam Cooling Period Ends

SEATTLE — The cooling of over ten million cubic yards of concrete in the Grand Coulee Dam has been completed. The job required two large pump barges, 2000 mi. of pipe, 2 mi. of 3½-ft. inspection shafts, nearly 6 mi. of other galleries and shafts, and five years. The work was completed at an estimated cost of $1,400,000.

The cooling program reduced concrete temperatures from as high as 132F to the uniform temperature of 45F required. Steel tubing was embedded in the dam and cold river water was circulated through the tubes. Water was circulated at the rate of 4 gallons per minute through each of the thin-walled 1-inch pipes. One of the barges had five pumps with a capacity of 3500 gallons per minute; the other, six pumps with a capacity of 5500 gallons per minute. By natural cooling the mass of concrete would not have cooled for a century.

Yant Heads Dust Committee

NEW YORK—William P. Yant, director of research and development of the Mine Safety Appliances Company, Pittsburgh, was elected chairman of the American Standards Association sectional committee on toxic dusts and gases at its recent meeting. In addition to its regular work, the committee is now working on allowable concentrations for eight toxic substances which are in use in industries manufacturing materials for the defense program. Dr. C. D. Selby, member-at-large on the committee, was elected vice-chairman.

Mr. Yant succeeds Dr. R. R. Sayers, who resigned because of the increasing pressure of his duties as Director of the U. S. Bureau of Mines. A resolution of appreciation to Dr. Sayers for his work as a member of the committee and as its chairman was voted by the committee.

Buffalo Chapter Elects Heath

BUFFALO—William R. Heath, Buffalo Forge Company, was elected president of the Western New York chapter, ASHVE, at the annual meeting in the University Club May 19. He succeeds Clarence A. Gifford, American Radiator Company. Other officers for the coming year are:

First vice president, Harry C. Schafer, Iroquois Gas Corp.; second vice president, Seelye M. Quackenbush, Quackenbush Co.; secretary, Herman Seelbach, Jr., Minneapolis-Honeywell Regulator Co.; and treasurer, Bertram C. Candee, Beman & Candee. The officers were installed following the election.

MAGGIE AND MARTHA

Studies on how to keep warm at night are responsible for the two young ladies shown here. At the left is Maggie, a straw dummy in long underwear, who spent the winter on the roof of the General Electric factory in Bridgeport under a G.E. automatic electric blanket. Her underwear is electrically wired to reproduce the average surface body temperature of a human being in sleep. The engineer is shown taking readings of the charts which recorded outside temperature and electrical consumption of the automatic blanket. At the right is shown Martha Alden, very definitely not a straw dummy, who is Pequot Mills' sleep consultant. In her left hand is the thermostatic control which maintains an even temperature in the G.E. blanket, regardless of outside temperature changes.

IBR Praised for Its Standards

WASHINGTON—The Institute of Boiler and Radiator Manufacturers received a certificate of honorable mention in the American Trade Association Executives' ninth annual competition for outstanding trade association services in 1940 "to members, the industry and the general public."

This and other awards in the contest were presented at the annual meeting of the American Trade Association Executives, held here April 28, by Under-Secretary of Commerce Wayne Chatfield Taylor, on behalf of Secretary of Commerce Jesse H. Jones, who headed the jury which made the selections but who was unable to attend the session.

The Institute of Boiler and Radiator Manufacturers won its award: "For its achievement in developing common standards of performance of boilers used in residential heating and reliable methods of selecting proper sizes and types for heating comfort. These were based on exhaustive laboratory tests in which not only all member firms but also most non-members participated."

ASRE Group Elects Thompson

PHILADELPHIA—The Philadelphia section of the ASRE held its annual meeting May 9 at the Penn Athletic Club, and inducted the newly elected officers for 1941-1942, as follows: Chairman, R. J. Thompson, Kinetic Chemicals, Inc.; first vice-chairman, A. B. Chamberlain; second vice-chairman, Harry Klinger; secretary-treasurer, R. E. Frederick.

Underground Parking Lot Under Way

SAN FRANCISCO — An underground parking lot, with a mechanical ventilating system to change the air every 10 minutes, is now under construction here. The structure, known as the Union Square Garage, is the first subsurface parking area in a downtown section in North America. This subterranean structure when completed some 10 months hence will be four stories in depth and will have a garage capacity of 1400 cars on aisles, all double parking being avoided. The architect is Timothy L. Pflueger of San Francisco.

The size of the underground building will be 275 feet by 415 feet with 113,500 square feet on each full floor and 88,500 on the top or entrance floor. The entrance floor is slightly less in area than the other floors because of the difference in height between the two extreme corners of the park.

New Haven Adds A.C. Diner

BOSTON — A novel new air conditioned dining car has recently been added to the New York and Boston run of the Yankee Clipper by the New York, New Haven & Hartford Railroad. The car is called "The Whaler," because of the striking nautical decorations and finish, which catch the spell of old New Bedford and Nantucket whaling days.

The car was air conditioned by the B. F. Sturtevant Company, using ice. About 1½ tons of ice are consumed for the air conditioning on the Boston-New York run, 2100 pounds being loaded in at the start of the trip and more added at New Haven.

MINNEAPOLIS-HONEYWELL PLANT VISITED BY LORD HALIFAX

In a recent visit to the Minneapolis plant of the Minneapolis-Honeywell Regulator Company, which is engaged in several important defense contracts involving precision instruments for war work, Lord Halifax, British Ambassador to the United States, could not escape the iron-clad rule that everyone visiting the plant must state his business and sign the roster, and he is shown here signing the visitors' book. Left to right, C. B. Sweatt, vice-president, Minneapolis-Honeywell Regulator Co., Lord Halifax, and H. W. Sweatt, president of Minneapolis-Honeywell.

N.E. Anthracite Meeting Planned

NEW YORK—Members of the anthracite and allied industries, including architects, equipment manufacturers and representatives of industrial concerns in New England will convene June 19 and 20 at the Massachusetts Institute of Technology for the First Annual New England Conference on Anthracite Utilization. This conference is being sponsored by the Commonwealth of Massachusetts University Extension in cooperation with various local and national organizations.

The purpose of this conference is to present for consideration and discussion the recent and rapid technological progress being made in the production, distribution and utilization of Pennsylvania Anthracite. All papers on the two-day program have been previously presented at one of the Anthracite Conferences held annually at Lehigh University. Each of these papers has been revised and brought up to date.

Included on the program:

"Factors Affecting Human Comfort in Addition to Temperature," C. P. Yaglou, Harvard School of Public Health; "Progress Performance of Domestic Anthracite Stokers," Henry F. Miller, sales manager, Hershey Machine and Foundry Co., Motorstokor Division; "Recent Research at Anthracite Industries Laboratory," Allen J. Johnson, director, Anthracite Industries Laboratory; "Anthracite Research at Mellon Institute," H. J. Rose, anthracite fellowship, Mellon Institute; "Trends in Boiler and Furnace Design for Greater Efficiencies with Anthracite," M. A. Young, general manager, Catskill Metal Works; "Practical Merchandising of Anthracite from the Retail Dealer Viewpoint," C. A. Fraser, president, Carl A. Fraser, Inc.; "Market Opportunities for Anthracite," J. D. Jillson, sales engineer, Anthracite Industries, Inc.; "Magazine and Self-Feed Principle Applied to Anthracite Burning Equipment," J. E. Axeman, general sales manager, Spencer Heater Div., Aviation Manufacturing Corp.; "Practical Pointers in Domestic Stoker Installations," A. H. Bearse, Jr., New England manager, Anthracite Industries, Inc.; "The Use of Degree Day Calculation in the Retail Coal Industry," L. N. Burnside, manager equipment sales, D. L. & W. Coal Co.; "Performance of Anthracite Fired Water Heaters," R. C. Johnson, Mellon Institute; "Practical Results from the Burning of Anthracite on Commercial Under-Feed Stokers," William Stein, Combustion Engineering Co.; and "Thermostatically Controlling Anthracite Burning Equipment," Arnold Michelson, vice-president, Minneapolis-Honeywell Regulator Co.

The conference is under the chairmanship of James A. Moyer, Massachusetts University Extension.

148 A.C. Installations in New York for First Quarter of 1941

NEW YORK—One hundred and fifty-eight air conditioning installations totaling 4018.96 hp. were added to the lines of the Consolidated Edison Company of New York, Inc., during the first four months of 1941, according to statistics released by that utility. These installations included 140 self-contained air conditioning units totaling 664.47 hp.

The total installations, including the self-contained units, made in each of the four major boroughs of New York during the first four months are:

TOTAL NEW YORK AIR CONDITIONING INSTALLATIONS, JAN.-APR., 1941

BOROUGH	NO.	HP.
Manhattan	102	2352.68
Brooklyn	34	311.29
Bronx	12	481.66
Queens	10	873.33
TOTAL	158	4018.96

The location of the 140 self-contained units is as follows:

SELF-CONTAINED AIR CONDITIONING UNITS INSTALLED IN N. Y., JAN.-APR., 1941

(THESE ARE INCLUDED IN THE TOTALS IN THE PRECEDING TABLE)

BOROUGH	NO.	HP.
Manhattan	96	437.27
Brooklyn	29	124.54
Bronx	7	53.16
Queens	8	43.50
TOTAL	140	664.47

The complete breakdown by size and by type of building in which the air conditioning was installed is as follows:

200,000 Defense Houses Needed

WASHINGTON—At least 200,000 houses for defense workers are needed now and perhaps another 200,000 next year, J. C. Nichols, chief of the supply section of the Office of Production Management, told the National Conference on Home Building held by the Home Builders' Institute of America here May 15.

The institute, beginning a three-day session, is the new professional branch of the National Association of Real Estate Boards.

"In my opinion," said Mr. Nichols, "defense housing construction must be held to the absolute minimum. I believe, where we know the demand is temporary and private industry cannot afford to build, we should make every effort to use dormitories, or floating hotels, trailers, mobile houses, demountable houses, or the cheapest construction consistent with decent living standards; otherwise, I view with alarm the impact on other existing home values after the emergency; and the discouragement of new home building when it will be so sadly needed to give wide employment in our aftermath.

"Shall modern, up-to-date, permanent defense houses in many communities only further create blighted residential areas of competing older houses, still good and serviceable?

"Certainly today speed in most instances is too great to stop to clear slums, but let us not create more slums for the future."

David D. Bohannon of Los Angeles, institute president, said home building may cushion the post-defense let-down.

Standards for Soldered Joint Fittings

NEW YORK—With the completion, approval, and recent publication of the American Standard for Soldered-Joint Fittings, the ASA subcommittee which prepared the standard has completed the first part of its program. The standard covers dimensions of soldered-joint wrought metal and cast brass fittings for copper tubing including detailed dimensions of the bore, minimum specifications for materials, minimum inside diameter of the fitting, metal thickness for both wrought metal and cast brass fittings, and general dimensions for cast brass fittings including center-to-shoulder dimensions for both straight and reducing cast fittings.

The pressure and temperature ratings given in this standard are limited by the properties of the 50-50 tin-lead solder which is used to make the joints, the subcommittee explains. The fittings defined by the standard as well as the copper tubing with which they are designed to be used, however, are suitable for use at higher pressures and temperatures than can be safely permitted when this soft (50-50 tin-lead) solder is used. They also have better corrosion-resisting properties than does the solder. The properties given in the standard for this solder are those assigned to it in the National Bureau of Standards' report of September, 1940.

At the request of the subcommittee, A. R. Maupin, of the research committee of the sectional committee on plumbing and plumbing equipment, is now carrying on a research program on a number of other solders.

AIR CONDITIONING INSTALLATIONS IN NEW YORK CITY, JAN. TO APR., INCL., 1941
(From data compiled by Consolidated Edison Co. of New York, Inc.)

APPLICATION	MANHATTAN						BROOKLYN						BRONX						QUEENS					
	0-10 HP.		10-20 HP.		OVER 20 HP.		0-10 HP.		10-20 HP.		OVER 20 HP.		0-10 HP.		10-20 HP.		OVER 20 HP.		0-10 HP.		10-20 HP.		OVER 20 HP.	
	NO.	HP.	NO.	HP.	NO.	HP.	NO.	HP.	NO.	HP.	NO.	HP.	NO.	HP.	NO.	HP.	NO.	HP.	NO.	HP.	NO.	HP.	NO.	HP.
Residential	2	10.	1	16.5	0	0	2	1.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bank	0	0	0	0	1	60	0	0	0	0	1	51.	0	0	0	0	0	0	1	3.33	0	0	0	0
Funeral Home	0	0	1	18.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hospital Laboratory	2	5.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Office Building	0	0	0	0	3	220.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Offices, Miscellaneous	16	39.5	2	29.5	7	380.75	7	12.	2	23.5	1	43.5	1	9.	0	0	0	0	1	1.	0	0	0	0
Restaurants	3	15.	3	54.	10	625.75	3	17.25	4	58.5	0	0	0	0	3	46.5	1	30.	2	13.	0	0	0	0
Showrooms	21	131.24	5	66.	1	28.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stores—Department	0	0	0	0	2	436.	0	0	0	0	0	0	0	0	0	0	2	372.5	0	0	0	0	1	32.5
Stores—Retail	6	26.83	1	18.	2	58.16	8	27.29	0	0	0	0	3	8.66	1	11.5	0	0	2	13.	0	0	0	0
Theatre	0	0	1	20.	0	0	0	0	1	12.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Commercial	1	1.13	1	18.83	0	0	1	3.	0	0	0	0	1	3.5	0	0	0	0	0	0	0	0	0	0
Drug and Chemical Mfg.	1	4.	0	0	0	0	1	1.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fur Vaults	2	5.83	2	34.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Printing and Lithography	2	8.58	0	0	0	0	1	3.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Textile Mfg.	1	6.83	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Industrial	2	14.5	0	0	0	0	1	1.5	0	0	1	55.	0	0	0	0	0	0	1	7.	0	0	2	803.5
TOTAL	59	268.69	17	275.33	26	1,808.66	24	67.29	7	94.5	3	149.5	5	21.16	4	58.	3	402.5	7	37.33	0	0	3	836.0

House Building Up in Defense Areas

WASHINGTON — Nearly 160,000 new small homes have been provided under the FHA program since July 1, when the defense program began creating urgent demands for low-cost housing in the important industrial centers, Federal Housing Administrator Abner H. Ferguson announced May 17. This represented an expansion of 30% over the comparable period a year earlier.

As examples of the rapidity with which new construction under the FHA program has expanded in response to the new demands created by the defense program, Mr. Ferguson cited the unusually sharp gains which have occurred in a sample group of industrial areas where the increase in operations by defense industries has been especially marked.

In the area served by the FHA's Hartford insuring office, an important center for aircraft production, the number of homes started under FHA inspection since July 1 of last year has increased by 167% over the comparable period of last year. In the Philadelphia area, the increase has been 43%. In the Richmond insuring office area, which includes the important shipyards centered around Norfolk, the expansion has been 65%.

At such other points of sharply expanding defense industry activity as Detroit, Chicago, Pittsburgh, Cincinnati and San Francisco, new construction under the FHA program has increased by between 34 and 110% during the period.

Currently, the weekly volume of new construction started under FHA inspection is continuing to set new high records. In the week ended May 10, a total of 4959 new homes were started as compared with 4377 in the like week of 1940.

N. J. Automatic Heating Up 50%

CAMDEN, N. J.—An increase approximating 50% in South Jersey automatic heating installations thus far this year over the corresponding 1940 period is reported by automatic heating dealers in this area, who say that the industry here is experiencing its greatest boom of many years.

Virtually all new dwellings which have been and are being erected in this area, it is reported, are providing automatic heating and domestic hot water supply. It is further noted that old dwellings put on the market for sale, in numerous cases, in order to be more salable, have also included in their renovizing, the installation of automatic heat.

It is estimated that within the past 10 years more than 20,000 homes in the Camden-South Jersey section have installed automatic heating.

I.B.R. Heating Research Described at Chicago Meeting

CHICAGO — The largest meeting of the year with 95 present was held by the Illinois chapter of the ASHVE on April 14 at which the speakers gave talks on the I.B.R. Research Home.

Professor M. K. Fahnestock, research associate professor of mechanical engineering at the University, had as his subject "I.B.R. Research in Steam and Hot Water Heating," in which he reviewed the activities of the Institute of Boiler and Radiator Manufacturers to further radiator heat.

Mentioned as probably the most important technical accomplishment of the Institute to date was the successful formulation and the gaining of acceptance of the I.B.R. testing and rating code for low pressure heating boilers. It was pointed out that a majority of the manufacturers of cast iron boilers were endorsing and using the code, and the Heating, Piping and Air Conditioning Contractors National Association was including I.B.R. ratings in its publication "Net Load Recommendations for Heating Boilers." The second major technical activity of the Institute was given as the research program, dedicated to the economical and technical improvement of steam and water heating for residences. The new I.B.R. Research Home, located near the campus of the University in Urbana, and the complete instrumentation of the house was described.

W. S. Harris, research associate mechanical engineer at the University, spoke on "The I.B.R. Research Home." Mr. Harris described the one-pipe forced circulation hot-water heating system which has been in operation since January 1, when the tests were started. The results given included the power and fuel consumption of the heating system and the air temperature gradients maintained in the rooms of the house with different weather conditions; the air temperatures maintained at the 30 in. level throughout the house, the inlet and outlet boiler water temperature and the temperature of the supply and return water to a typical radiator during a complete operating cycle. These data were given for two operating conditions: one, with the flow valve closed during the off period of the circulator and the temperature of the boiler maintained at a level suitable for heating domestic hot water, and, two, with the flow-valve open at all times and the water in the boiler permitted to cool as much as possible during the off-period. The difference in the fuel consumption for these two methods of operation was explained due to the difference in the standby heat losses from the boiler, it being larger when the boiler water temperature was kept at a high temperature during the off periods.

Burner Wiring Code Completed

BOSTON—Two hundred members of the Massachusetts Oil Heating Association met for the fifth regular meeting of the organization May 14. Guest speakers were William H. Greenlaw, past president of the International Municipal Signal Association and chairman of the committee for the uniform code for wiring power burners, and Clyde G. Morrill, advisor of the Oil Men's Council.

Mr. Greenlaw reported that the joint committee of oil burner men, wire chiefs, and wire inspectors' associations had completed the rough draft of the code and hoped to have it ready for approval by the state fire marshal very shortly. This would provide a code for wiring domestic burners that, after approval by the fire marshal, Governor and Council, would have the effect of law and all municipalities would have to abide by it.

Mr. Morrill spoke on the flood of reports that have upset oil and oil burner men regarding the imposition of special taxes, price increases, tanker shortage, and so on, and urged all present to accept no statements that were not official. There is no doubt, he said, that there is plenty of oil, in fact more unproved oil ground than there is in any other country, and that pipe lines could be built to take care of New England needs should a tanker shortage develop.

Mr. Greenlaw, who has been appointed chairman of the national committee on national defense, for the International Municipal Signal Association, stated that the uniform code would set up sequences for oil burner wiring with a provision that any further protective devices would be connected in the same sequence in their proper relation to the others.

Rema Re-elects Officers

FRENCH LICK, IND.—E. A. Vallee, Automatic Products Co., was re-elected president of the Refrigeration Equipment Manufacturers Association at a meeting here during May. At the meeting opening moves were made in preparation for the 1942 All-Industry Refrigeration & Air Conditioning Exhibition to be held next January in Chicago.

Other officers re-elected by the Association are W. C. Allen, Modern Equipment Corp., vice-president; R. H. Luscombe, Penn Electric Switch Co., treasurer; and R. M. McClure, executive secretary.

John Wylie, Jr., Temprite Products Corp., was elected secretary of the Association.

New directors elected included J. A. Strachan, Kerotest Mfg. Co.; Mr. Luscombe, and Mr. Wylie.

Adequate Mine Ventilation Needed

CHARLESTON, W. VA.—Increased mechanization of coal mining, with its accompanying greater release of coal dust, demands adequate ventilation and other control measures if the health of bituminous miners is to be protected, Dr. R. R. Sayers, director of the U. S. Bureau of Mines, warned in a paper presented here May 12 at a discussion of industrial health before the West Virginia State Medical Association.

Noting that under the old methods of hand mining the amount of dust raised was of relatively little importance to the health and safety of miners, Dr. Sayers added:

"This condition is quite the opposite in mechanical mining operations. As most of the large mines use mechanical methods and their use is increasing rapidly in other mines, that phase is of great importance now and seems certain to become more important in the future.

"However, if suitable control measures are instituted, the health and safety of miners will be protected."

Dr. Sayers declared that wet methods will bring about material abatement in almost all operations and adequate ventilation will serve to replace dusty air with clean air.

Besides the health dangers, through tendency toward respiratory diseases, the speaker pointed out that bituminous dust is an ever-present explosion hazard and must be controlled.

After discussing various dangerous gases Dr. Sayers stated:

"Remedial measures and safe operations of coal mines require positive and adequate volumes of air to the mine face for proper dilution of these gases and, as it may be impracticable to supply enough air at all points where methane is liberated, additional safeguards in the use of electricity, explosives or other means of ignition are necessary, as well as the use of adequate respiratory protective devices when men must enter such an atmosphere."

Burners, Stokers May be Taxed

WASHINGTON—Two advisers of President Roosevelt laid before the House Ways and Means Committee on May 7 identical plans for raising $3,600,000,000 in revenue for defense and at the same time opposed the Treasury's plan as putting the wrong emphasis on our economy during the emergency period. The witnesses were Leon Henderson and Marriner S. Eccles.

Among the proposals were those extending excise levies to oil burners, stokers, automobiles, parts and accessories, tires and tubes, washing machines, and electric refrigerators and watches and clocks.

ACRMA Adopts Six Standards; Elects Murphy President

WASHINGTON—The Air Conditioning and Refrigerating Machinery Association, Inc., in its meetings at Hot Springs, Va., early in May, approved and adopted six important equipment standards. These cover: self-contained cooling air conditioning units; self-contained room coolers and self-contained room air conditioners; freon-12 evaporative condenser units; horizontal closed shell-and-tube freon-12 condensers; freon-12 liquid receivers; and location and inspection of data plate on insulated refrigerant-containing vessels.

E. T. Murphy

E. T. Murphy, Carrier Corporation, was elected president for the coming year, to be assisted by C. E. Wilson, Worthington Pump and Machinery Corporation, as first vice-president; J. P. Rainbault, General Electric Company, as second vice-president; and P. A. McKittrick, Parks-Cramer Company, as treasurer.

W. H. Aubrey, Frick Company, Inc., was elected to the chairmanship of the board of directors. In addition to the officers, the members of the board are: P. Y. Danley, Westinghouse Electric and Mfg. Co.; J. M. Fernald, Baker Ice Machine Company, Inc.; F. T. Goes, The Vilter Mfg. Co.; G. A. Heuser, Henry Vogt Machine Co.; S. E. Lauer, York Ice Machinery Corp.; D. W. Russell, Airtemp Division, Chrysler Corp.; H. R. Sewell, B. F. Sturtevant Co., and G. E. Wallis, The Creamery Package Mfg. Co.

William B. Henderson continues as executive vice-president of the association.

Hedges Elected by Phila. Chapter

PHILADELPHIA—At the annual meeting of the Philadelphia chapter of the ASHVE held May 8 at the Bala Country Club, the following new officers for 1941-1942 were installed: President, H. Berkley Hedges, John J. Nesbitt, Inc.; first vice-president, Harry H. Mather, Philadelphia Electric Co.; second vice-president, Edwin Elliot, Edwin Elliot & Co.; treasurer, Arthur C. Caldwell, P. Gormly Co.; secretary, Rush D. Touton, Bayuk Cigars, Inc.

Chicago Adds 60 A.C. Jobs

CHICAGO—Sixty new central air conditioning systems in Chicago were added to the lines of the Commonwealth Edison Company during the month of April. The capacities of these plants were 1016¾-ton and 1198 hp.

Knighton Shows Absorption Market

DALLAS—The flexibility of gas-fired air conditioning equipment in following the load was stressed in a talk by John K. Knighton, sales manager of air conditioning, Servel, Inc., on "Year Round Air Conditioning and Commercial Refrigeration," presented May 6 here before the Industrial and Commercial Sales Sessions of the 1941 A.G.A. Natural Gas Convention.

In discussing the basic differences between mechanical compression refrigeration equipment and absorption refrigeration Mr. Knighton said that " . . . the application problem of air conditioning for summer comfort cooling is met most ideally when the exact capacity of equipment is matched with the exact requirement of the job, and this can be done with gas by regulating the input to the requirement—certainly an electric motor is not so flexible.

"Then from an air conditioning point of view, comfortable conditions are maintained on an even keel somewhat in proportion to the hours of operation of equipment in accordance with demand. Here, again, gas absorption refrigeration comes to the fore with an ideal answer, in that, by step modulation, refrigeration can be maintained over a longer period in direct proportion to the requirement of the job, and thus maintain a satisfactory condition of both temperature and humidity, whereas electric compression equipment must operate 'full on' or 'full off'—actuated only by the maximum capacity required and permits of wide fluctuations in humidity—certainly not conducive to human comfort.

"We then come to the inherent advantages of absorption refrigeration, such as no moving parts, nothing to wear out, low maintenance cost, and assured long life, valuable points of difference that I am sure you are familiar with through your gas refrigeration activities."

N. J. Factory Building Up 250%

TRENTON, N. J.—Indicating a continued high level of industrial building construction activity in New Jersey, State Labor Commissioner John J. Toohey, Jr., announced May 20 the approval by the State Labor Department during April of 126 plans having an aggregate valuation of $1,301,100.

The number of industrial plans approved is three and a half times the average for the past 22 years, and the valuation is nearly twice the average cost of construction for the same period. The current report further indicates there were 39 more plans approved than for the corresponding month a year ago and the valuation was $370,022.06 more than in April of last year.

Franklin Institute Honors Carrier

PHILADELPHIA—The award for the first time of the Frank P. Brown medal for improvements in the building and allied industries was made by Franklin Institute of Philadelphia May 21 to Dr. Willis H. Carrier as "a pioneer in the creation and development of the science of air conditioning."

Dr. Carrier, chairman of the board of Carrier Corporation, received the medal from Philip C. Staples, president of Franklin Institute and the Bell Telephone Co. of Pennsylvania, at the annual Medal Day exercises.

Anti-Smoke Group Picks Harrisburg

HARRISBURG, PA.—Location of a national headquarters for the Sunshine Society, now in process of organization, is being discussed by interested persons in the more than 100 cities where active campaigns against the smoke nuisance are being conducted, it was announced yesterday by Logan B. Sisson, formerly of the Air Pollution Investigation at Mellon Institute. He has suggested Harrisburg as a logical city for the home office of the association of smoke fighters.

Considerable mention has been made of Columbus, Ohio, as a good place for a home office, Sisson said, pointing out that this choice has probably been influenced by the research work in bituminous coal being done by Battelle Institute there. He remarked that equally important research in anthracite as well as bituminous coal is being conducted at The Pennsylvania State College and that both as a fuel producer and fuel-user Pennsylvania is not outranked by any northern state.

Made Chairman of Turner Const. Co.

NEW YORK—H. C. Turner, founder of the Turner Construction Company and president since its organization 39 years ago, has been elected to the newly created position of chairman of the board of directors of the company. He has been succeeded as president by J. Archer Turner, former executive vice-president.

Under the leadership of H. C. Turner, the yearly business of the company has grown from a total volume of $40,000 in 1902 to an estimated volume of $40,000,000 in 1941. During this period the company has completed more than 1600 buildings.

Defense Housing Bill Passed

WASHINGTON—The House on May 7 passed and sent to the Senate another urgent deficiency appropriation bill, totalling $173,749,630, of which $165,000,000 is to go for permanent and temporary defense housing.

The House Naval Affairs Committee meanwhile authorized construction of eleven major naval lighter-than-air craft bases.

HeatingContractorsPlanConvention at San Francisco

NEW YORK—Plans for the 52nd annual convention of the Heating, Piping & Air Conditioning Contractors National Association, to be held at the Hotel St. Francis, San Francisco, June 15-19, have been announced.

The first session on Monday morning, June 16, will be a joint meeting with the American Society of Heating and Ventilating Engineers whose summer meeting is scheduled at the Palace Hotel during the same week.

At 2 p.m., June 16, the Pacific Heating and Air Conditioning Exposition will open at the Civic Auditorium.

On Tuesday and Wednesday the engineers and contractors alternate meetings so that members can attend the sessions of both organizations.

The program follows:

JUNE 16—10 A.M.

Joint session with ASHVE.
Greetings from San Francisco.
Response by N. H. Peterson, president, Heating and Piping Contractors Association of San Francisco.

12:15 p.m.

Joint luncheon with ASHVE.

7 p.m.

Annual dinner and dance.

JUNE 17—9:30 A.M.

President's Address—J. E. McNevin.
Report of the Treasurer.
Report of Auditing Committee.
Report of Boiler Output Committee.
Report of Publication Committee.
Address.
Report of Committee on Welding.

7 p.m.

Round Table Discussions—Committee chairmen will arrange group meetings for those who wish to discuss special subjects at greater length than is possible on convention floor.

JUNE 18—2 P.M.

Report of Membership Committee.
Report of Committee on Standards.
Report of Committee on Air Conditioning.
Report of Secretary.
Report of Committee on Apprenticeship.
Address—Defense Construction.
Report of Committee on Trade Promotion.
Report on Plumbing and Heating Industries Bureau.
Conditions in the Industry—Report by representatives from Atlantic Seaboard, Mississippi Valley and Pacific Coast.

JUNE 19—9 A.M.

Report on Committee of Ten—Coal and Heating Industries.
Report on American Standards Association.
Report of Committee on Certification.
"Practical Benefits of the I.B.R. Research Program"—R. E. Ferry, general manager, The Institute of Boiler and Radiator Manufacturers.
"Radiator Heating in the Small Home."
Election and Installation of Officers.

New England to Have A.C. Institute

BOSTON—New England's Second Air Conditioning Institute, which will be an annual affair in the future, will be held June 23-24 at Massachusetts Institute of Technology, under the joint sponsorship of the Air Conditioning Bureau, local chapters of the ASHVE, ASRE, ASME and the Air Conditioning Manufacturers' Association.

Los Angeles Group Elects Hess

LOS ANGELES—Arthur Hess, heating engineer of the staff of English & Lauer, Inc., Los Angeles, was elected president of the Los Angeles chapter, ASHVE, at the May 14 meeting. Other officers and board members elected at this meeting were: vice-president, H. H. Bullock, General Electric Co.; secretary, Leo Hungerford, Utility Fan Co.; treasurer, Westley Stewart, Johnson Service Co. Board members: Howard Douglas, Edison Electric Co.; Frank Parks, Western Air Refrigeration, Inc.; Melville Kerwin, York Ice Machinery Corp.; and James Griffith.

The educational session of the meeting was highlighted by an address by Henry Sachs, chief engineer of the Utility Fan Corp. of Los Angeles on "Evaporative Cooling." Mr. Sachs prefaced his talk with a brief history of evaporative cooling, touched upon its now nationwide development, and discussed various installations of this type. He led up to a conclusion that evaporative cooling has become an important phase of air-conditioning.

President Asks Oil Pipelines

WASHINGTON — President Roosevelt told Congress May 20 that there is a "distinct possibility" that it will be necessary to restrict oil consumption on the Atlantic seaboard "within a few months" unless legislation is adopted to facilitate construction of pipelines from southwestern fields.

Calling attention to a bill introduced in the House by Representative William P. Cole to facilitate the construction or extension of pipelines as a defense measure, President Roosevelt said in a letter to Speaker Rayburn and Representative Cole:

"The vast concentration of industry, population and military bases on the Atlantic coast is now dependent for petroleum upon tankers plying between the Gulf Coast and the Middle Atlantic ports. Not only is this water route long and potentially perilous, but even present demands upon these transportation facilities make restriction of oil consumption to essential uses a distinct possibility."

Funds for construction would be taken from any available defense appropriation.

Economical Dust Control

In the article "Economical Dust Control with Low Resistance Exhaust Systems," Part 6, by F. F. Kravath, in the April issue of HEATING AND VENTILATING, the captions for Figs. 11-A and 11-B were reversed. The illustration at the right is in reality Fig. 11-A while the one at the left is Fig. 11-B, and should have been so labeled.

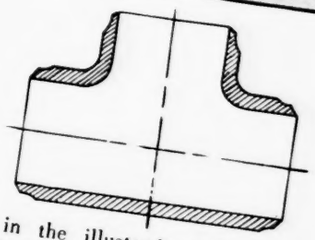
Number of Degree-Days for April, 1941

HEATING & VENTILATING continues its thirteenth year of publishing degree-day data for various large cities. Forty-four cities have been added to the list of those previously published. A total of 114 cities are listed below.

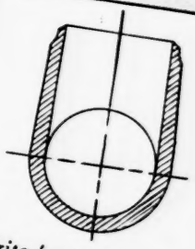
	Degree-Days April, 1940	Degree-Days April, 1941	Deg. Days Season, 1940-41
Albany, N. Y.	698	408	6871
Alpena, Mich.	—	590	7294
Atlanta, Ga.	210	88	3077
Atlantic City, N. J.	—	382	4786
Baker, Ore.	—	565	5753
Baltimore, Md.	442	213	4318
Binghamton, N. Y.	—	393	6525
Birmingham, Ala.	150	42	2622
Bismarck, N. D.	—	580	7978
Boise, Idaho	—	448	5037
Boston, Mass.	642	409	5794
Buffalo, N. Y.	744	501	6528
Burlington, Vt.	773	517	7661
Cairo, Ill.	—	133	3796
Canton, N. Y.	—	522	7916
Charles City, Iowa	—	378	6900
Charlotte, N. C.	—	113	3197
Chattanooga, Tenn.	—	119	3640
Cheyenne, Wyo.	691	731	6413
Chicago, Ill.	614	396	5783
Cincinnati, Ohio	455	227	4758
Cleveland, Ohio	657	413	5693
Columbia, Mo.	—	216	4581
Columbus, Ohio	516	247	5112
Concord, N. H.	—	424	6743
Concordia, Kan.	—	293	5165
Davenport, Iowa	—	302	5685
Dayton, Ohio	—	267	5207
Denver, Colo.	513	547	5222
Des Moines, Iowa	506	301	5771
Detroit, Mich.	662	393	6140
Dodge City, Kan.	364	338	4656
Dubuque, Iowa	—	332	6196
Duluth, Minn.	839	628	8212
Eastport, Me.	—	700	7350
Elkins, W. Va.	—	340	5554
El Paso, Tex.	93	152	2333
Erie, Pa.	693	452	5975
Escanaba, Mich.	—	640	7479
Evansville, Ind.	342	205	4478
Fort Smith, Ark.	—	85	3072
Fort Wayne, Ind.	584	352	5826
Fort Worth, Tex.	134	72	2397
Grand Rapids, Mich.	620	363	6139
Green Bay, Wis.	723	492	7148
Greensboro, N. C.	—	195	3987
Harrisburg, Pa.	523	256	5252
Hartford, Conn.	638	378	6121
Helena, Mont.	—	625	6886
Huron, S. D.	—	436	7123
Indianapolis, Ind.	480	233	5012
Ithaca, N. Y.	669	418	6535
Kansas City, Mo.	362	207	4630
Keokuk, Iowa	—	272	5168
Knoxville, Tenn.	247	119	3579
La Crosse, Wis.	604	328	6762
Lander, Wyo.	—	714	7361
Lansing, Mich.	687	404	6535
Lincoln, Neb.	451	332	5555
Little Rock, Ark.	202	70	2924
Los Angeles, Calif.	115	177	1008
Louisville, Ky.	359	178	4195
Lynchburg, Va.	—	165	3934
Madison, Wis.	654	401	6773
Marquette, Mich.	—	590	7305
Memphis, Tenn.	196	76	2995
Milwaukee, Wis.	707	476	6387
Minneapolis, Minn.	639	378	7322
Nantucket, Mass.	—	553	5466
Nashville, Tenn.	259	95	3513
New Haven, Conn.	602	355	5599
New Orleans, La.	48	0	1215
New York, N. Y.	571	291	5076
Norfolk, Va.	301	203	3461
Northfield, Vt.	—	566	8050
North Platte, Neb.	—	436	5741
Oklahoma City, Okla.	228	148	3479
Omaha, Neb.	473	303	5655
Oswego, N. Y.	—	523	6710
Parkersburg, W. Va.	—	220	4803
Peoria, Ill.	456	298	5523
Philadelphia, Pa.	501	236	4761
Pittsburgh, Pa.	504	253	5147
Pocatello, Idaho	—	633	6193
Portland, Me.	738	557	6313
Portland, Ore.	295	256	3194
Providence, R. I.	617	376	5640
Pueblo, Colo.	—	469	5220
Raleigh, N. C.	—	140	3401
Reading, Pa.	528	258	5218
Reno, Nev.	444	562	4757
Richmond, Va.	343	192	3990
Rochester, N. Y.	676	468	6727
Roseburg, Ore.	—	350	3283
St. Joseph, Mo.	—	247	4935
St. Louis, Mo.	349	186	4290
Salt Lake City, Utah	375	508	4895
Sandusky, Ohio	—	404	5754
San Francisco, Calif.	221	277	1776
Sault Ste. Marie, Mich.	—	585	7920
Scranton, Pa.	633	332	6128
Seattle, Wash.	327	296	3214
Spokane, Wash.	435	397	5174
Springfield, Ill.	418	239	4937
Springfield, Mo.	—	196	3712
Syracuse, N. Y.	688	453	6761
Tacoma, Wash.	—	341	3583
Terre Haute, Ind.	—	219	4850
Toledo, Ohio	627	380	5909
Trenton, N. J.	554	274	5188
Utica, N. Y.	720	403	7026
Washington, D. C.	426	204	4343
Wichita, Kan.	343	247	4504
Yakima, Wash.	—	280	4652

(—) Indicates data not available.

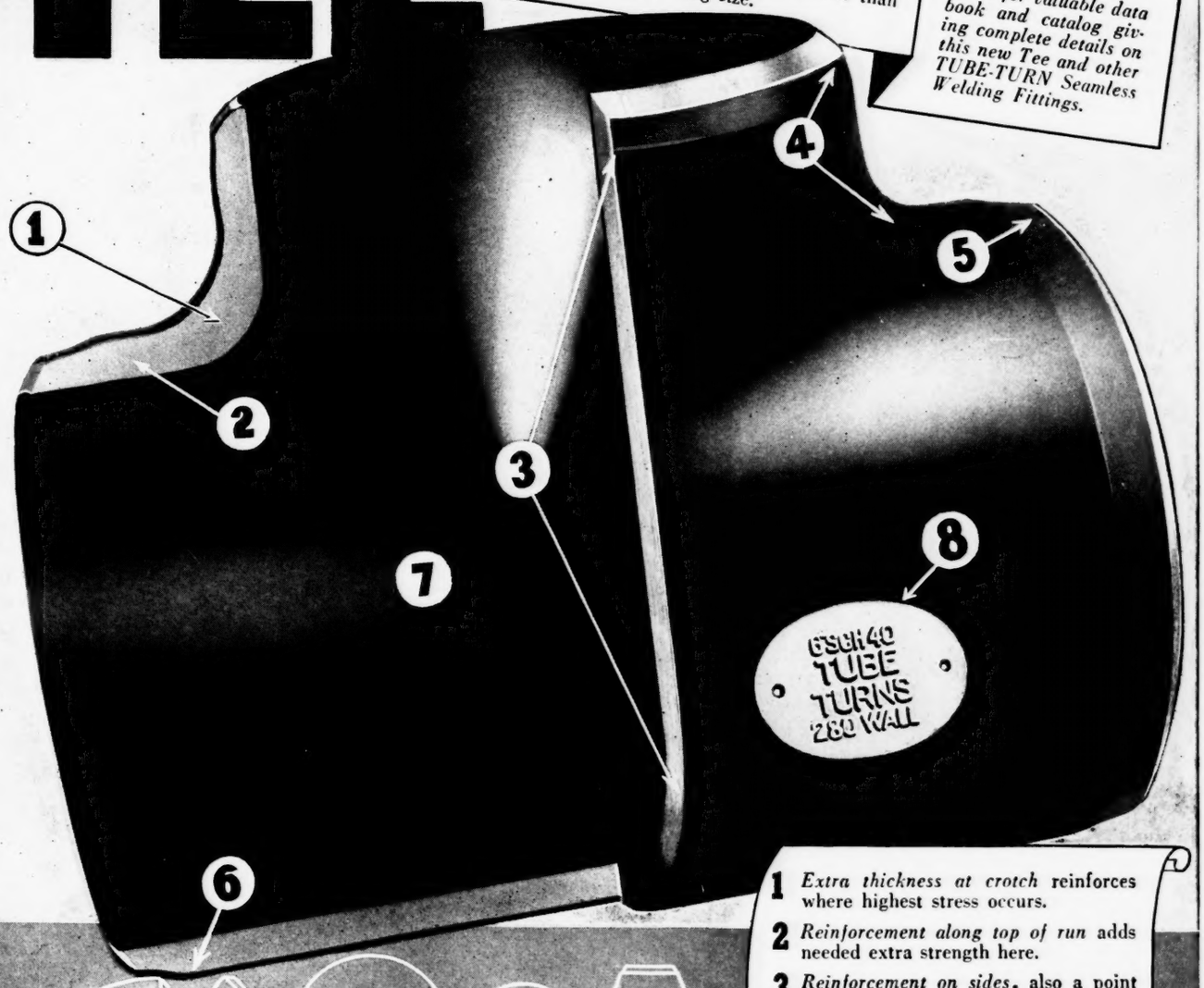
8 reasons for specifying TUBE-TURN Welding TEE



Note in the illustrations here how the reinforcement is placed at *all* points of higher-than-normal stress. Numerous bursting-pressure tests prove that TUBE-TURN Tees will withstand higher pressures than pipe of corresponding size.



Write for valuable data book and catalog giving complete details on this new Tee and other TUBE-TURN Seamless Welding Fittings.



1 *Extra thickness at crotch* reinforces where highest stress occurs.

2 *Reinforcement along top of run* adds needed extra strength here.

3 *Reinforcement on sides,* also a point of high stress, gradually tapers toward end of outlet and bottom of run.

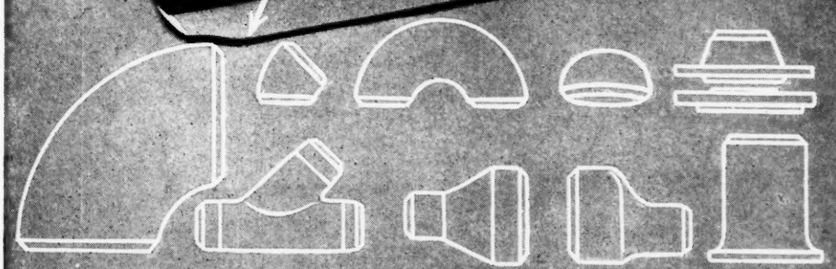
4 *Longer outlet* permits faster lining up and ample room for rod manipulation.

5 *Ends machined* to exact pipe wall thickness—easy to align and weld.

6 *Increased thickness at bottom* adds to full strength without excess weight.

7 *Smooth inside walls, curved inner crotch and special manufacturing process* assure even flow.

8 *Size, material, thickness and name* identified on permanent name-plate.

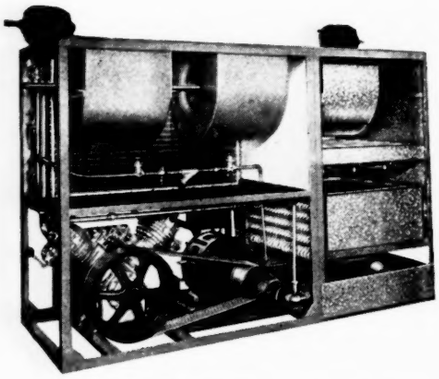


TUBE-TURNS

The original welding fittings—and still the best!

TUBE-TURNS, Inc., LOUISVILLE, KY. • *Branches:* New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Los Angeles, San Francisco, Greenville

NEW EQUIPMENT



A complete air conditioning system in one package.

U.S. Air Conditioning System

NAME—Refrigerated Kooler-aire.

PURPOSE—A complete refrigerated air conditioning system includes cooling, dehumidifying and circulating unit, refrigerating unit and evaporative condenser unit all in one package.

FEATURES—Unit consists of a refrigeration compressor, air cooling, dehumidifying and circulating unit, evaporative condenser unit all included in one cabinet which is shipped completely assembled, tested and ready to operate as soon as three connections are made. These connections are electrical, air duct, and water supply and drain. The unit is equipped with a push-button starting and stopping switch and automatic thermostatic temperature control.

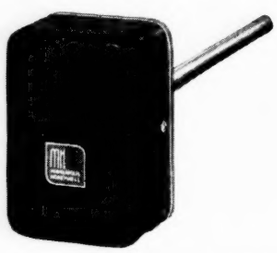
SIZES AND CAPACITIES—Six sizes, 5 to 25 hp., of capacities ranging from 68,000 to 308,000 B.t.u. per hr. at 82F D.B., 67.2 W.B. air entering conditioner and 77F air entering evaporative condenser.

MADE BY—*United States Air Conditioning Corporation, Northwestern Terminal, Minneapolis, Minn.*

M-H Thermostats

NAME—Master and Submaster insertion thermostats.

PURPOSE—Submaster thermostat may be used to operate valve or dampers to control the temperature of air or liquids while the Master thermostat, measuring the temperature of some other medium such as outdoor air, automatically sets the control point of the Submaster as the outdoor temperature changes.



Submaster insertion thermostat.

FEATURES—These thermostats are the pneumatic type and it is said that the sensitive rod and tube type of element permits accurate control over a wide range of temperatures. Both controllers have a scale range of —20 to 120F. The Submaster controller may be adjusted to increase the control point 25 to 150F. The Master controller may be adjusted to produce the desired change in control point as the temperature of the outdoor air (or other medium) increases or decreases over a span of from 15 to 75F. Economical use of compressed air is said to be assured because of the non-bleed type of construction. No air is allowed to bleed from the system except when the damper or valve is changing position. All adjustments are located inside the case to discourage tampering but are said to be accessible when the cover is removed.

MADE BY—*Minneapolis - Honeywell Regulator Co., 2950 Fourth Ave., South, Minneapolis, Minn.*

Perfex Damper Operator

For controlling the operation of boilers.

NAME—Thermo-Draulic Damper Operator.

PURPOSE—A simplified damper control for domestic hand-fired coal or coke heating systems.

FEATURES—The operating arm is connected to the furnace draft door and damper and is actuated by a sealed liquid which is vaporized by heat from a heater coil energized by a thermostat or other control. Instrument is said to function promptly with ample throw and power in full damper movement. Manufacturer states that the control will return the system to the checked position in case of power failure, broken wire, or any damage to the hydraulic system. Control is sold separately or in sets which include thermostat, limit control, transformer and all necessary installation accessories.

MADE BY—*Perfex Corporation, 500 West Oklahoma Ave., Milwaukee, Wis.*

For industrial ventilation.

DeBothezat Man Cooling Fan

NAME—Hy-V Air Jet man cooler.

PURPOSE—A specially designed fan for reducing fatigue of workmen in foundries, forge shops, steel mills, and other plants where the workers are exposed to radiant heat.

FEATURES—The unit projects a blast of air in a concentrated stream to remote spaces without the aid of ducts. It is said to combine a high efficiency axial flow pressure fan and an aerodynamically proportioned nozzle. In this unit the static pressure produced by the fan is converted into velocity energy. Fan is available for either column or floor mounting and can be adjusted to blow in any direction. Tilting of the fan is controlled by a small crank and screw which prevents accidental tipping of the unit.

MADE BY—*DeBothezat Ventilating Equipment Division, American Machine and Metals, Inc., East Moline, Ill.*

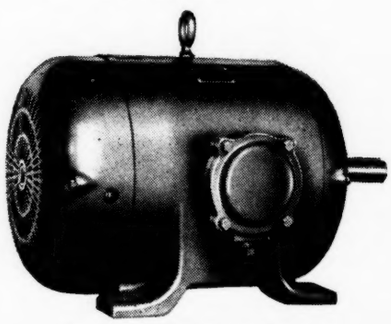
Explosion-Proof Motor

NAME—Century explosion proof motor for Class II, Group G atmospheres.

PURPOSE—For use in atmospheres having explosive grain dusts.

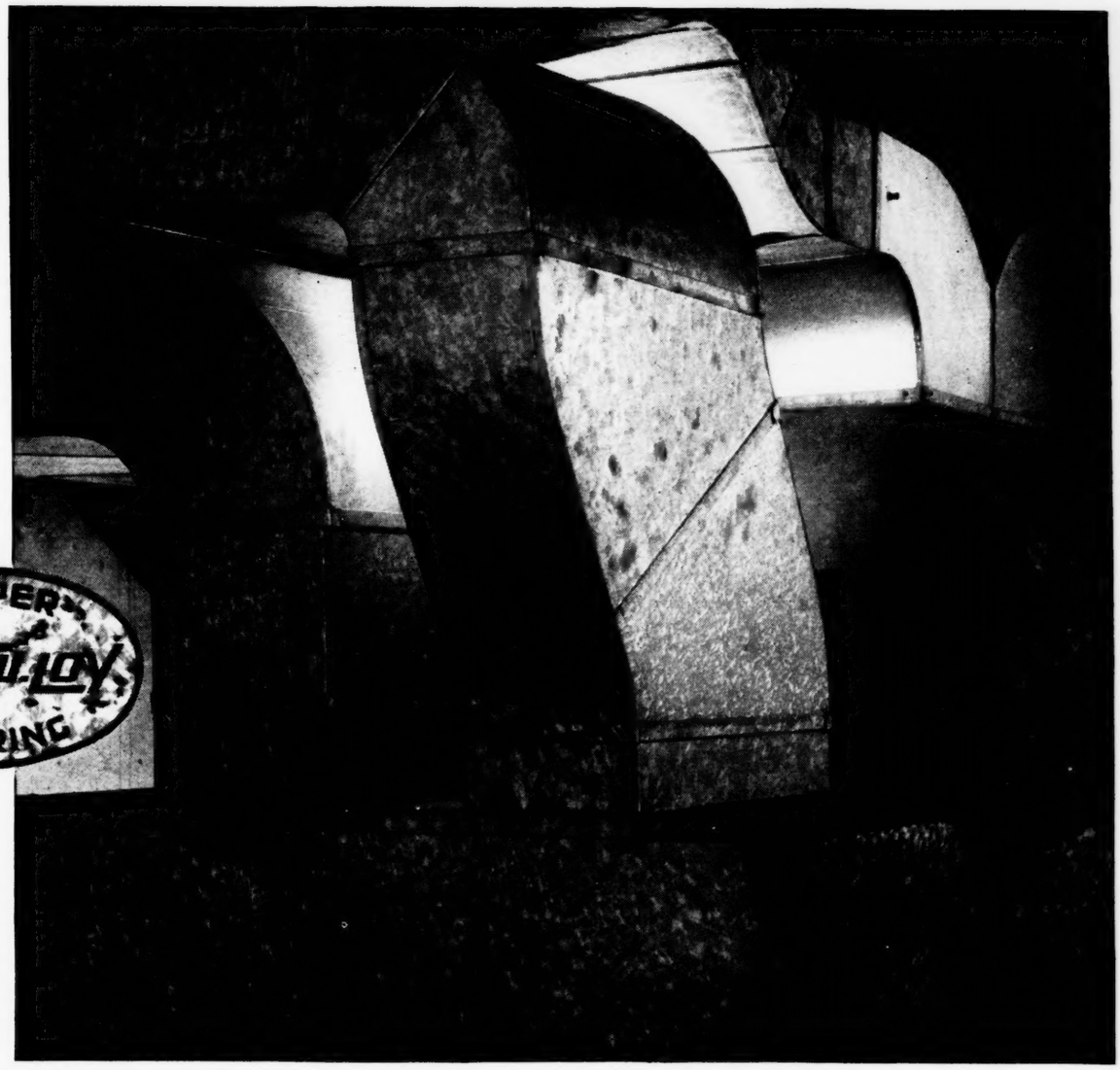
FEATURES—Cooling air is forced through the large air passages surrounding motor closures at a velocity which resists clogging.

MADE BY—*Century Electric Co., 1806 Pine St., St. Louis, Mo.*



Century explosion proof motor.

Give 'em dollars more in value for a few cents more per sheet

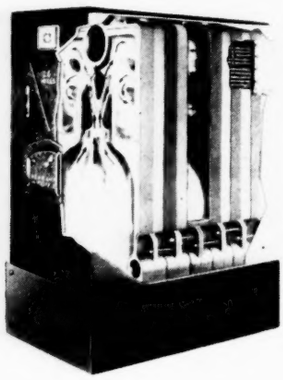


with Beth-Cu-Loy Galvanized Steel Sheets

. . . And that's why more and more contractors are standardizing on Beth-Cu-Loy for all duct work. When you build with Copper-Bearing Beth-Cu-Loy, you can assure customers of double life for their ducts. Impartial tests by the American Society for Testing Materials have repeatedly proved that steel sheets identical in analysis with Beth-Cu-Loy outlast ordinary sheets more than two to one. That's a real dollar-value you can give your customers for an added cost of only a few cents more per sheet. For lasting jobs, build with Beth-Cu-Loy.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY



For medium size buildings.

Smith Heating Boiler

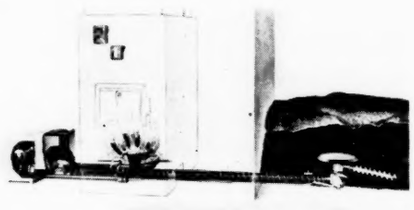
NAME—No. 20 Smith-Mills boiler.
PURPOSE—For supplying hot water or steam for medium size homes, service stations, diners or small buildings.
FEATURES—Boiler is manufactured in models for oil firing and for stokers. Hand-fired model will be introduced a little later in the season. Manufacturer states that particular care has been given to make provision for widely different types of domestic hot water loads and a number of different size built-in tank and tankless heaters are available. It is further stated that as this boiler has not only horizontal but also vertical and lateral flues there is a high proportion of direct heating surface. Fins have been placed where the gases are hottest. These features are combined with the utilization of a modified down-draft travel and are said to result in a highly efficient performance.
SIZES AND CAPACITIES—From 675 to 1275 sq. ft. installed steam radiator surface and 1080 to 2040 sq. ft. hot water radiator surface.
MADE BY—*The H. B. Smith Company, Incorporated, Westfield, Mass.*

Johns-Manville Fire Brick

NAME—J-M fire brick.
PURPOSE—Insulating fire brick for temperatures from 1600 to 2600 F.
FEATURES—Bricks are furnished in four temperature limits: J-M-16 for exposed service to 1600F and for back-up service to 2000F, and JM-20, JM-23, and JM-26 for exposed or back-up temperatures to 2000, 2300, and 2600F respectively. This new fire brick is produced from a plastic refractory clay and an organic filler which upon being burnt out during the manufacturing process is said to give a uniform, controlled pore structure and impart the characteristics of light weight and high insulating value.
MADE BY—*Johns-Manville, 22 East 40th Street, New York, N. Y.*

Pocahontas Coal Stoker

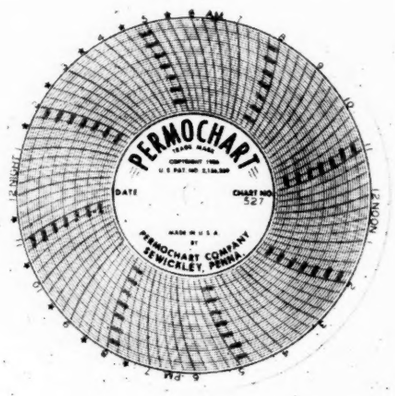
NAME—Original Pocahontas coal burner Model D.
PURPOSE—For burning bituminous coal.
FEATURES—This stoker features a new vertical ash container which is filled by forcing the ash upward through an opening in the bottom of the container. Container is fitted with a shut-off valve operated by a handle at the top. Other features include revolving grates, a rotary coal collector which is said to eliminate the need for expensive sloping sides to the coal bin, and a specially designed supersensitive fire-banking control operated directly by the temperature of the fire.
MADE BY—*Stoker Division, Pocahontas Fuel Company Incorporated, Cleveland, Ohio.*



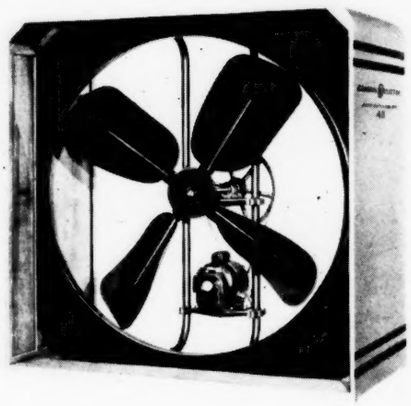
Features an up-feed ash container.

Permochart Instrument Chart

NAME—Permochart.
PURPOSE—A permanent plastic chart for use on any circular recording instrument. Ink may be removed by wiping chart with a damp cloth and chart reused.
FEATURES—Chart is made of vinylite plastic and can be easily cleaned with a damp cloth. Manufacturer states that the charts are non-inflammable and will not curl and are not affected by oil, gasoline or grease. These charts are attached and removed from meters in the same manner as paper charts and the same pens are used.
MADE BY—*Permochart Company, Edgeworth, Sewickley, Pa.*



A permanent recording chart.



G-E attic fans.

General Electric Attic Fans

NAME—G-E home cooling unit.
PURPOSE—For removing large volumes of air from homes.
FEATURES—Unit consists of a belt-driven four blade propeller fan, motor, and wood housing. Housing itself is mounted on wood blocks and the wood casing is designed to prevent transmission of noise.
SIZES—Three sizes, 36, 42, and 48 in.
MADE BY—*General Electric Co., Bridgeport, Conn.*

M-H Time Controller

NAME—Minneapolis-Honeywell time controller.
PURPOSE—For automatically controlling the operating period of attic fans, refrigeration systems, store lighting, and other electrical devices.
FEATURES—Timing mechanism may be set to close a circuit for any period of time from ½ to 11 hours by twisting the knob on the front of the instrument until desired time period appears in the window. When this period has elapsed, switch will automatically open and break circuit to electrical load. To open circuit at any time, if this is necessary, knob can be turned in opposite direction back to zero. Controller is equipped with snap action, single-pole, double-throw switch so that it may also be used to interrupt an electrical circuit and then after a definite period of time reclose the circuit. This makes it suitable for temporarily shutting down refrigeration systems to allow defrosting of coils. Arranged for flush mounting in a standard two-gang outlet box.
SIZES AND CAPACITIES—Contact capacity is sufficient to handle electrical loads as high as 1 hp. or 10 amp. at 110 volts a.c. and 1½ hp. or 5 amp. at 220 volts a.c.
MADE BY—*Minneapolis-Honeywell Regulator Company, 2950 4th Ave., South, Minneapolis, Minn.*

all Season
AIR CONDITIONING
BY *McQuay*

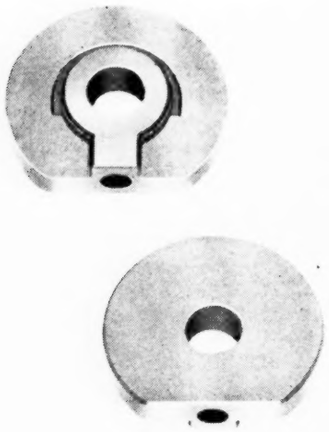
- COOLING
- HEATING
- HUMIDIFYING
- DEHUMIDIFYING
- CLEANING
- CIRCULATING

McQUAY year 'round Air Conditioners perform any or all of the six fundamental air conditioning functions. They are flexible enough to exactly meet the requirements of each individual job. McQuay units can be selected to perform the basic functions with provisions for adding additional functions, as the need arises. McQuay Air Conditioners are furnished in a wide range of sizes and models, either suspended or floor type. All units use heating or cooling coils having the exclusive McQuay construction, whereby the copper tube is hydraulically expanded into the wide fin collar making a permanent bond without the use of solder. In addition to these popular year 'round conditioners, McQuay builds a full line of heat transfer equipment for all types of industrial process applications . . . . McQuay, Inc., 1619 Broadway Street, N.E., Minneapolis, Minn. Representatives in all principal cities.

McQuay INC.

Air Conditioners . . . Air Conditioning Coils . . . Blast Coils . . . Blower Coolers . . . Comfort Coolers . . . Cabinet Radiation . . . Concealed Radiation . . . Evaporative Condensers . . . Indoor Cooling Towers . . . Ice Cube Makers . . . Icy-Flo Accumulators . . . Refrigerating Coils . . . Room Coolers . . . Unit Heaters . . . Unit Coolers . . . Water Cooling Units

PIONEER MANUFACTURERS OF EXTENDED SURFACE



Self-lubricating bearings.

Keystone Bronze Bearings

NAME—Selflube porous bronze bearings.

PURPOSE—A self-lubricating bearing which requires no oil vents or grease cups when used in other than heavy duty or continuous operating applications.

FEATURES—Selflube porous bearings are made from powdered alloys which are moulded to size in the shape desired, then baked and finally quenched in oil. They are said to have a porosity of 35% which enables them to store a large amount of oil which forms a protective continuous oil film on the bearing surface. Manufacturer states that in many cases this oil reserve lasts the entire life of the application, eliminating the use of oil vents or grease cups. Additional lubrication is recommended for heavy duty or continuous operating units. Bearings are said to have a tensile strength of over 35,000 lb. per sq. in. and have a low friction coefficient.

MADE BY—*Keystone Carbon Company, Saint Marys, Pa.*

Sturtevant Fan

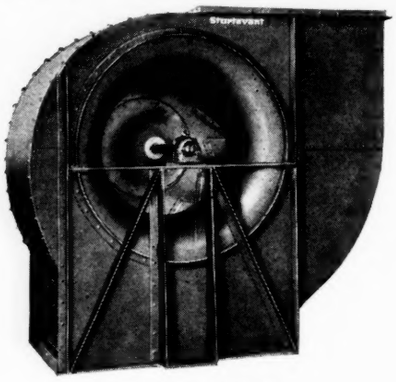
NAME—Silentvane design 8 fan.

PURPOSE—Designed primarily for heating, ventilating and air conditioning application.

FEATURES—Manufacturer states that this fan possesses two characteristics which particularly suit it for heating, ventilating, and air conditioning duties—that is, quietness of operation and low outlet velocity. Housings are made of steel plate with strong rolled bead joints reinforced with heavy bracing angles. Side and back plates of rotor are cut from heavy stock and back plate is securely riveted to cast iron hub. Blades are die-formed riveted to back plate and welded to the shroud. In accordance with NAFM standards for class 1 fans, these fans are designed for a maximum tip speed of 9000 fpm. Manufacturer also claims the following features: (1) reduced power consumption, (2) lower maintenance cost, (3) slow rotative and peripheral speeds, (4) high efficiency over large operating range, and (5) self-limiting horsepower characteristics with gradually increasing horsepower and volume until the maximum efficiency is reached.

SIZES—This fan is available in all standard discharges, single and double width, single and double inlet with wheel diameters ranging from 12¼ in. to 87¾ in.

MADE BY—*B. F. Sturtevant Company, Hyde Park, Boston, Mass.*



Silentvane design No. 8.

Viking Roof Ventilator

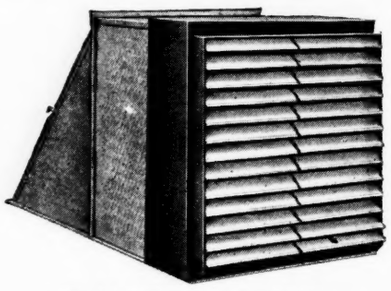
NAME—Model "R" Viking roof ventilator.

PURPOSE—For ventilating flat roof buildings.

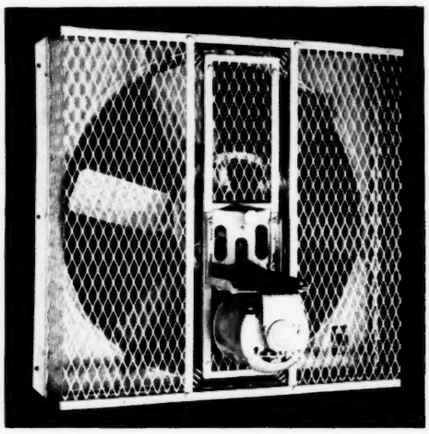
FEATURES—This is a complete unit consisting of a Viking high capacity fan assembly enclosed in a weatherproof penthouse of heavy galvanized iron and automatic shutter. It can be flashed directly to the roof slab since flanges are provided for this purpose. An outstanding feature is said to be an automatic vertical shutter which consists of light weight, hardened aluminum vanes supported by steel shafts pivoted in bronze bearings. The shutter vanes are held open by a unique arrangement as long as the fan is in operation so as to reduce the resistance.

SIZES AND CAPACITIES—Three sizes with capacities 7500, 11,500 and 16,500 c.f.m., respectively.

MADE BY—*Viking Air Conditioning Corporation, 9500 Richmond Ave., S.E., Cleveland, Ohio.*



Model "R" Viking ventilator.



Coolair window fan.

American Coolair Window Fan

NAME—Coolair window fan type 28-W.

PURPOSE—For large volume ventilation of rooms.

FEATURES—A complete window fan unit ready for instant mounting and operation. It is equipped with side mounting flanges which fasten directly to the inside or outside frame of an ordinary window. Fan may be placed in upper or lower half of window without interfering with operation of window sash. Adjustable diameter motor pulley permits changing fan speed to suit the job. Fan is equipped with a reversible motor and reversing plug for blow-in or exhaust operation.

SIZES AND CAPACITIES—Overall width 33 in.; height 31 in.; 6000 c.f.m.

MADE BY—*American Coolair Corp., Jacksonville, Fla.*

Taylor Direct-Set Ratio Controller

NAME—Taylor ratio controller.

PURPOSE—For applications where a temperature, pressure, rate of flow or liquid level must be controlled in a desired ratio or differential to another related variable.

FEATURES—Controller is said to be a highly adaptable, easily convertible instrument for applications where it is desired to control temperature, pressure, rate of flow or liquid level in accordance with pre-set ratio or differential to another related variable. Manufacturer states that this ratio can be changed by a simple screw-driver adjustment directly on a calibrated dial throughout the range of 0 to 1 or 3 to 1, direct or inverse. This controller has two measuring systems: one the adjusting system, which indicates or records only, and the other, the controlling system, which may either indicate or record. The adjusting system re-sets the control point according to a predetermined ratio.

LITERATURE AVAILABLE—Bulletin 98158.

MADE BY—*Taylor Instrument Companies, Rochester, N. Y.*

RESPONSIBLE Refrigerant Control..

● Today in many refrigerated storage rooms the country over, large shipments of perishable foods are being held for reshipment or ageing.

● That, which guards these foods from spoilage, is this little valve—a dependable A-P Thermostatic Expansion Valve.

● Have you ever before realized the responsibility that rests in this little valve? It far outshines the mechanical and engineering perfection built into it by A-P.

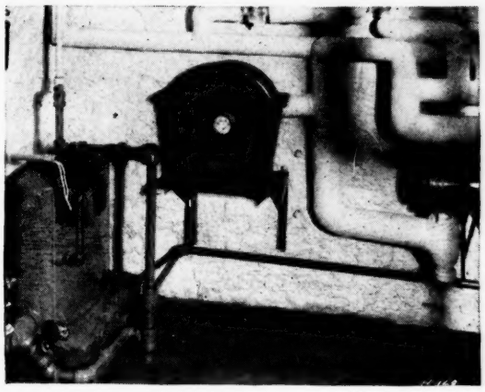
● When you service or install equipment that guards perishable products insist on A-P Valves. They're Dependable. And fulfill their responsibility to you and to your customers—dependably.

● *Progressive Service Engineers use and Recommend—and aggressive Jobbers stock and talk A-P Products.*

AUTOMATIC PRODUCTS COMPANY
2462 NORTH THIRTY-SECOND STREET
MILWAUKEE WISCONSIN
Export Department—100 Varick St., New York City
A-P CONTROLS ARE DEPENDABLE

GET ACCURATE STEAM COSTS FOR HEATING, PROCESSING WITH THE

ADSCO ROTARY CONDENSATION METER



One of several ADSCO Rotary Condensation Meters at the Kansas University, Lawrence, Kan.

Available in 7 sizes
250-12,000 lbs. per hour capacity

Totalizes Steam Consumption per Building or Department—Helps You Detect Steam Losses and Improve UTILIZATION

The ADSCO Rotary Condensation Meter is the low cost answer to establishing accurate costs for steam heating per building or department. It is low in first cost, requires little maintenance beyond periodic cleaning, is easy to install, operates under vacuum or gravity conditions and is factory tested to an accuracy within 1%.

Hundreds of these meters are standard equipment on the lines of district heating companies to provide the basis for monthly billing and are used by leading industrial plants, colleges, institutions, federal, state and municipal departments.

Write for quotation giving maximum pounds of condensate per hour that the meter would be required to handle or the square feet of equivalent direct radiation in the building or department to be metered.

Write for illustrated Bulletin No. 35-80V.

AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA, N.Y.
IN BUSINESS OVER SIXTY YEARS

WITH THE MANUFACTURERS

Air Conditioning Co., Houston, Tex., recently moved into new and larger quarters. The new building, built especially for the company, includes space for showroom, warehousing, and the sheet-metal department. The company, organized five years ago with a staff of five employes, today has a staff of 36. *James A. Walsh* is president of the company and *A. J. Mitchell* is vice-president. *R. W. Kurtz* is chief engineer and secretary; *E. B. Cobb* is manager of the commercial refrigeration department, and *J. C. Rose* is manager of architects and contractors division.

Amirton Company, Inc., manufacturers of air filters, announce the removal of their offices from 60 East 42nd Street to 27 Pearl Street, New York City.

A. M. Byers Co., Pittsburgh, Pa., will enter the field of alloy steel manufacture about June 15, when its new electric furnace equipment will be placed in initial operation. Available alloy steel production for America's defense needs will then be increased by another 30,000 to 40,000 tons a year, according to *L. F. Rains*, president. Construction of a plant addition and the installation of electric furnace equipment at the Byers Ambridge works have been speeded because of the shortage of alloy steel in the present emergency, Mr. Rains stated, and added that production will begin six weeks ahead of the original schedule.

Armstrong Cork Co., Lancaster, Pa., has expanded the functions of its advertising department to include all promotional activity, and appointed *M. J. Warnock* as director of advertising and promotion and *E. Cameron Hawley* as assistant director of advertising and promotion. Mr. Warnock joined the Armstrong organization in 1926, spending the following three and one-half years in the Seattle district as a salesman and later as district manager. He became an assistant manager of the floor division in 1930, and earlier this year was named assistant general sales manager. In his new position, Mr. Warnock succeeds John P. Young, resigned. Mr. Hawley joined the Armstrong organization in 1927 as a member of the advertising department. He was later assistant sales manager of the corkwood division, director of commercial research, and since 1936 has been director of the bureau of retail merchandising for the floor division.

Bell and Gossett Company, Chicago, held its 25th anniversary sales meeting at the Union League Club May 7-9. The annual B & G Convention came as a finale to a sales contest promoted under the name of the "B & G Battle Royal." Men were divided into two teams, captained by "*Slug*" *Bornquist* of Chicago and "*Spike*" *Bitzer* of Philadelphia. In addition to the contest awards, every man present received a leather bag completely equipped with engineering data.

Bell and Gossett anniversary dinner.

Builders Iron Foundry, Providence, R. I., announce that its metering business is now being conducted under the name of *Builders-Providence, Inc.* It is pointed out that this is a change of name only. In fact, Builders-Providence, Inc., is a division of Builders Iron Foundry and has the same directors and officers.

Copper & Brass Research Association, New York, reports that *Penn Brass & Copper Co.*, Erie, Pa., manufacturers of seamless copper and brass tubes, dehydrated refrigerator copper tubes and related products, has been elected to membership.

Gale Products, Air Conditioning Dept., Galesburg, Ill., reports that the air conditioning dealer can greatly increase his volume if he will rent room coolers; that too much emphasis has been placed on the product itself and not enough on the pleasant atmosphere it manufactures, and that distributors and dealers in several big cities achieved outstanding success with Gale rental programs last summer. They found that many people were willing to pay high prices for a roomful of conditioned air who could not be persuaded to buy the merchandise at the outset. The same people who thought that $150 or $200 was too much money for cooling one room had no hesitation in spending as much as $50 for the use of one of the machines for the summer. But once these rental customers had an opportunity to enjoy the benefits of a unit air conditioner, a large portion of them wished to buy. Each rental contract which distributors used last summer had an "option to buy" clause which gave the customer an opportunity to apply the entire amount of the rental contract price to the purchase price of the machine. Better than 25% bought before the end of the season.

York Ice Machinery Corporation, York, Pa., reports that since October, 1940, 1000 employees have been added to the factory and branch personnel of that company. In addition, 22% of the present employees are now working night shift. The increase in personnel is due in part to the increased defense production and also to subcontract items such as tanks, gun-mounts, and other munitions which the company is manufacturing.

Manufacturers Successors Inc., 150 Broadway, N. Y., is a new corporation chartered by the State of New York and composed of several nationally known supply companies. Richardson & Boynton Co., manufacturers of furnaces and boilers, have retired from business and their patterns have been purchased by Manufacturers Successors Inc., who will continue to furnish repair parts to their duly authorized agents. The new corporation has elected the following officers: President, *W. L. Healy*, Waverly Heating Supply Co., Boston; 1st Vice President, *J. H. Oswald*, H. C. Oswald Supply Co., Inc., N. Y.; 2nd Vice President, *J. C. Kaufman*, Associated Heater Parts Corp., Chicago; Treasurer, *E. H. Krekel*, Stove Manufacturers Corp., Newark; Secretary, *J. D. McLaughlin*, Heater Repair & Supply Co., Providence; General manager, *Bryan VanCleave* and Counsel, *W. F. Ashley, Jr.*

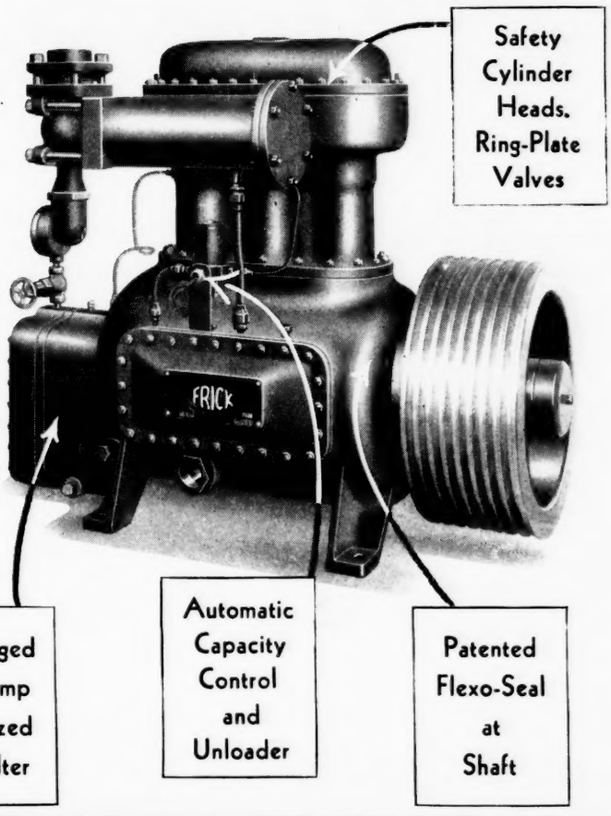
W. B. Connor Engineering Corp., 114 East 32nd St., New York, has purchased the assets of *Plandaire, Inc.*, Pittsburgh. The Plandaire business will be merged with the *Dorex Division* of the Connor organization, makers of Dorex odor adsorbers and Ace steam specialties. Plandaire is a manufacturer of ceiling diffusers.

The Logan Engineering Company, Chicago, has appointed *J. A. McCoy*, 1436 41st Place, Des Moines, Iowa, as representative in Iowa.

Distinctive Advantages Announced for the New

Eclipse

Refrigerating Machines

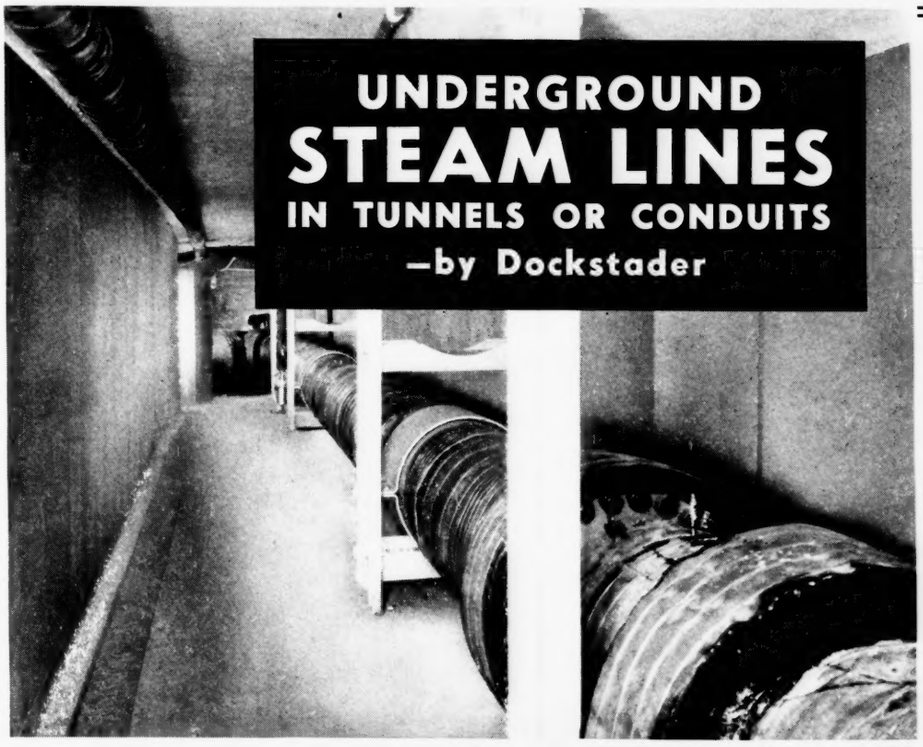

Safety Cylinder Heads. Ring-Plate Valves
Submerged Oil Pump Oversized Oil Filter
Automatic Capacity Control and Unloader
Patented Flexo-Seal at Shaft
FRICK

Don't buy ANY Freon-12 compressor until you've seen the new Frick Eclipse line! Built in three sizes, these phenomenal machines give capacities up to 60 tons refrigeration . . . in units so compact, light, efficient, and quiet they can be installed almost anywhere . . . and at a material saving over older types!

Only in the Eclipse line can you get all the exclusive advantages shown, plus such features as higher operating speeds (up to 900 r.p.m.), force-feed lubrication throughout, direct-connected motor drive when desired, two machines operating together (using the Frick oil-equalizing system), pistons with 5 rings, etc., etc. Nearly 60 years' refrigerating experience built into them.

Write, wire or phone your Frick Branch or Distributor for full details today. Or, get in touch with

DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA. U.S.A.



UNDERGROUND STEAM LINES IN TUNNELS OR CONDUITS —by Dockstader

WE specialize in designing and installing complete Steam Distribution Lines, including trench work, construction of conduits, tunnels, etc. Let us apply our specialized experience in figuring the best possible installation for your requirements.

Illustrated is a Dockstader job recently completed. Tunnel dimensions (inside) are 7 x 6½ ft. The bottom line is an 18" Steam Main carrying steam at 200 lb. pressure; the top line is a drip return. Note provision is made for a future line installation.

When you are figuring on similar installations or conduit types of construction, let Dockstader present a proposal based on extensive experience for the complete job. No obligation is attached to your inquiries.

S. E. DOCKSTADER, INC.

Piping Contractors MUNSEY BUILDING, WASHINGTON, D. C.

WELDED PIPE LINES AND UNDERGROUND STEAM MAINS A SPECIALTY

John H. Collier

Crane Co., Chicago, announces that its board of directors at a special meeting May 5 elected *John H. Collier* as president to fill the vacancy created by the death of Charles B. Nolte April 29. Mr. Collier was born in Chicago in 1884, was educated at Purdue University, and joined Crane Co., on leaving school in 1903. From his original position as coremaker's helper 38 years ago he has progressed through a variety of positions giving him a very intimate and thorough grasp of the company's activities. The later and more important positions in this list are: general manager, Bridgeport, Conn., plant, Crane Co., 1917-1929; president, Cie Crane, Paris, and chairman, Crane Ltd., London, 1929-1933; vice president in charge of manufacturing, Crane Co., Chicago, 1933-1941.

Jas. P. Marsh Corporation, Chicago, has appointed *Jordan Equipment Co.*, 10 East Town St., Columbus, Ohio, as its representative in the Columbus territory.

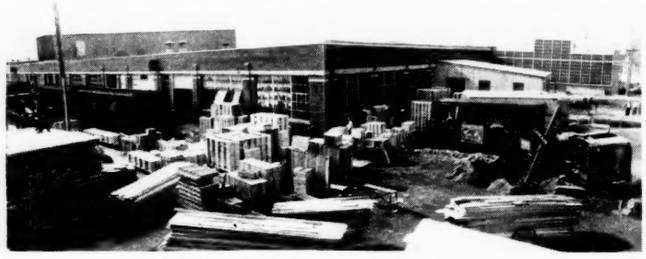
Pangborn Corporation, Hagerstown, Md., has moved its Philadelphia office to 901 Beury Building, 3701 North Broad Street. *Forrest G. Sharpe*, formerly assistant to the sales manager, has been appointed Philadelphia sales engineer to fill the vacancy caused by the death on April 14 of *William T. Randall*.

Research Products Corporation, Madison, Wis., has appointed three new representatives as follows: *Campbell-Elsey & Co.*, 326 Ness Bldg., Salt Lake City, Utah, to cover that State, eastern Nevada, and southern Idaho; *Ernest Wiggs & Associates*, 2077 East Fourth Street, Cleveland, Ohio, to cover Ohio; and *Gray Engineering Co.*, High Point, N. C., to cover Virginia.

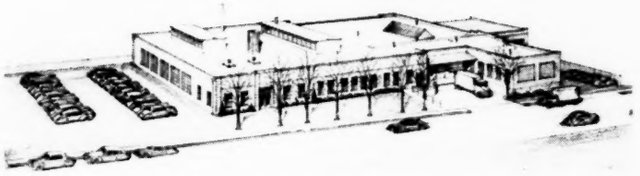
York Ice Machinery Corp., York, Pa., announces that its export division has completed transfer of its personnel from the Brooklyn office of the corporation to the main factory offices at York. This move has been made to enable the company to provide direct factory assistance for foreign representatives. All York export field supervisors and export sales engineering personnel will henceforth be in close contact with factory personnel, and will be able to give foreign distributors up-to-the-minute information.

Philco Corp., Philadelphia, reports sales of Philco air-conditioning units for the two months of April and May as 39.7% ahead of total sales for the entire season last year. Coupled with this increase in volume was the fact that the average unit value is up approximately 10% in comparison to 1940.

The Trane Company, La Crosse, Wis., has broken ground at its plant No. 2 for an addition to the shipping department—the third factory addition in two years. The new factory will be of brick construction, 162 ft long by 84 ft wide with a crane bay. The Austin Company, Cleveland, is contractor for the project.



New Trane shipping department.



Alco Valve's new addition.

Alco Valve Company, St. Louis, has completed extensive alterations and additions to its factory. The present addition is the third since the original building was acquired in 1934. The new building is of one-story brick construction, air conditioned. Production facilities have been increased 50% but two labor shifts will be required to take care of increasing business, the company reports. A complete new engineering laboratory is included in the company's new expansion plan. This laboratory contains three atmosphere and test rooms in which it is possible to produce any temperatures or humidities desired. The laboratory has its own steam plant, machine shop, transformers, and other equipment. The laboratory and drafting room can also be used as a test room and is so arranged that any comfort loads can be produced the year-round. A portion of the new factory space will be devoted to defense work.

Airtemp Division, Chrysler Corp., Dayton, Ohio, has appointed two regional sales supervisors. *James E. Wilson*, for the past year regional sales manager in Michigan and northern Ohio, is now regional sales supervisor for the middle-western area, with headquarters in Dayton. *H. A. Malcom*, formerly metropolitan manager of Westinghouse Electric Supply Co., New York, has joined the Division as regional sales supervisor in the southern and western territories. Mr. Wilson, who joined Chrysler in November, 1935, as wholesale manager for the Airtemp Division in the Michigan territory, in September, 1939, was promoted to branch manager in Detroit; in December of the same year he became district manager. A year ago he was made regional manager in Michigan and Ohio. His territory has shown the most rapid increase in the sale of Airtemp air-conditioning equipment. Prior to his five-year connection with Westinghouse, Mr. Malcom was sales manager with the Stover Company, Frigidaire distributors.

PERSONALS & PERSONNEL

Cochrane Corp., Philadelphia, has appointed *W. W. Tomes* to head its flow meter section. Mr. Tomes graduated from Purdue University in 1928 and has been associated with the Firestone Tire & Rubber Company in flow measurement and steam distribution work and, more recently, in meter field engineering and sales work. Assisting Mr. Tomes will be *W. C. Morrison*, lately associated with the Brooklyn Union Gas Company as a sales engineer. Mr. Morrison graduated from Polytechnic Institute of Brooklyn in 1936.

Donald S. Walker, for the past several years general sales manager of *Combustion Engineering Company, Inc.*, has been made vice president in charge of sales of that company. *H. G. Ebdon*, formerly assistant general sales manager, has been advanced to general sales manager.

Wherever QUIET *is essential use . . .*

Careyduct
THE ALL-ASBESTOS INSULATED DUCT

for AIR-CONDITIONING SYSTEMS

CAREYDUCT is made entirely of asbestos — combines both duct and insulation. Simple slip-joint construction and standardized parts make fitting on job easy and rapid. Cuts easily with saw; no shop work necessary.

CAREYDUCT "hushes" fan noises; reduces "speaking tube" effects. Air velocities may be increased without noise, enabling you to use smaller sizes—a saving in both materials cost and labor.

CAREYDUCT is fireproof; can't rust or rot. Makes a smoother, better-looking, more efficient job. Size for size, it costs LESS than insulated metal duct.

Bring your duct work up-to-date — keep customers satisfied—make more money—with CAREYDUCT. Write today for full details—address Dept. 49.

Section of Careyduct used in air conditioning system at Crosley Corporation's Stations WLW, WSAI and WLWO, Cincinnati.

THE PHILIP CAREY COMPANY • Lockland, Cincinnati, Ohio
Dependable Products Since 1873
IN CANADA: THE PHILIP CAREY COMPANY, LTD. Office and Factory: LENNOXVILLE, P. Q.

"Weather Sealed"

Rear View

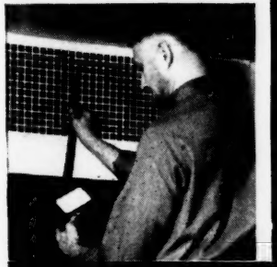
PROMPT DELIVERY

on Motor, Manual and Automatic Shutters and Back Draft Dampers . . . Stationary Louvers and Louver Dampers.

Wire or write for catalog and prices

AIR CONDITIONING PRODUCTS CO., 1232—18th St., DETROIT, MICH.

The All Purpose.... AIR VELOCITY METER



INSTANTANEOUS DIRECT READING
ASK FOR BULLETIN 2448D

Illinois Testing Laboratories Inc.
Don't Guess—Know!
143 W. HUBBARD ST., CHICAGO, ILL.

FOR DRYING AIR or GASES

CALORIDE

WHAT "CALORIDE" IS—"Caloride" is an especially designed, patented form of moisture absorbing chemical produced in the shape of hard, fused solid blocks as shown above.

WHAT IT DOES—Upon exposure to air, "Caloride" cubes attract moisture, gradually diminishing in size as moisture is absorbed. Due to their patented features, "Caloride" cubes retain their form until they are entirely dissolved—thus permitting free and continuous circulation of moisture laden air or gas through a suitable container filled with cubes.

WHERE USED—"Caloride" is used wherever there is a need for control of excessive humidity. "Caloride" prevents condensation and ends mold, mildew and other damage caused by excessive moisture in air. Its use is not restricted to any particular size or type of equipment—it is being used in commercial units handling large volumes of air as well as in small equipment designed for more limited application.

SEND FOR DETAILS

SOLVAY SALES CORPORATION • 40 Rector Street, New York, N. Y.
Please send complete details on "Caloride"—including prices, packages, new folder "Caloride For Drying Air or Gases."

*Name*_____

*Affiliated with*_____

*Address*_____

*City*_____ *State*_____ 85-641

An Explanation and Apology

The demands made upon us for the current National Defense Program for much of our type of equipment, plus the difficulties in obtaining raw materials from outside sources of supply, have made our deliveries and service much below our customary standards.

Government priorities must be and have been respected. Civilian and non-defense orders have of necessity suffered. With this explanation as to cause, we offer our apologies for whatever inconveniences and disappointments that have resulted or which may result in the future.

Our new plant facilities, (illustrated below) now being built and within sight of completion, will do much to relieve the present circumstances. We are glad that we shall shortly again be able to render the kind of service that has made these increased facilities necessary. Meanwhile, we respectfully ask your indulgence and forbearance.

MARLO

COIL COMPANY

6135 Manchester Ave., St. Louis, Mo.

Refrigerating Equipment Manufacturers

Koppers Coal Co., Pittsburgh, has promoted *Herbert N. Anderson*, assistant to the president of the New England Coal & Coke Company, to assistant general manager of sales, his principal activity to be the direction of railroad fuel sales. His headquarters will be in Pittsburgh but he will also maintain an office at 60 East 42nd Street, New York City; *Harold J. Spear*, assistant general manager of sales, now in charge of domestic sales, will assume direction of the commercial sale of Federal coal and of Koppers Pennsylvania coals. His headquarters will be Pittsburgh but he will also maintain an office in New York; *Henry D. Kidder*, now with the New England Coal & Coke Company, will move his headquarters to Pittsburgh where he will take charge of the distribution and shipments of Koppers Pennsylvania and Northern West Virginia coals; *L. J. Lozvell*, now district manager in Detroit, will become assistant general manager of sales with headquarters in Pittsburgh, and will direct the sale of domestic coal; *Richard A. Ewald*, now district manager in Cleveland, will become district manager in Detroit; *H. W. Crawford*, now in charge of lake sales in Chicago and Milwaukee, will become district manager in Cleveland, and *John S. Owens*, sales representative in Chicago, will handle sales in Wisconsin.

Louis N. Hunter, manager of research for National Radiator Company, has been elected vice-president of the company. Mr. Hunter, who joined National Radiator in 1930, will continue in charge of research development activities. He also has been appointed to the technical and advisory research committees of the Institute of Boiler and Radiator Manufacturers and the heating boiler code committee of the ASME.

Manning, Maxwell & Moore, Inc., Bridgeport, Conn., has transferred *T. J. Naughton*, formerly of the Chicago office, to Minneapolis; *E. C. Robinet*, formerly in the Los Angeles office, has been transferred to the Pacific Northwest territory, and will be located at Seattle; *J. E. Day* has been appointed representative in the Charlotte, N. C., district; *W. F. Williams* has joined the company to work with accounts in the oil industry, working out of Chicago; *Charles Stepan*, for the past several years working in the Chicago district, has been promoted to the newly-created position for the handling of sales of Consolidated safety valves, and boiler gauges and Ashcroft gauges for equipment manufacturers; *Joseph A. O'Connor*, for many years associated with the *United States Gauge Company*, and recently with the *Hartley Gauge Company*, will assist Mr. Stepan.

Brunner Manufacturing Co., Utica, N. Y., has elected *George L. Brunner, Jr.*, son of its president, to the position of executive vice-president.

Willard T. Lyons has been appointed plant superintendent of *The C. A. Olsen Mfg. Co.*, Elyria, Ohio. Mr. Lyons for the past 30 years, with the exception of a 3-year period when he was a member of the A.E.F. in France, has been actively engaged in the manufacture of steel heating equipment. For the past 7 years he was associated with *The Fox Furnace Company* and *The American Radiator and Standard Sanitary Corporation* at Elyria.

Crane Co., Chicago, has elected *V. P. Rumely* as vice-president in charge of manufacturing, to succeed *J. H. Collier*, who was made president early last month. Mr. Rumely has been works manager of the Crane Chicago plant for the past four years, during which he has been very closely associated with Mr. Collier.

Johns-Manville, New York, has appointed *Dr. C. F. Rassweiler* as director of research. Dr. Rassweiler has been director of the Philadelphia laboratory of E. I. duPont de Nemours Co. In his new position he will be a member of the officers board in charge of Johns-Manville's extensive research activities on which the company is spending close to a million dollars annually.

Born in Polo, Ill., Dr. Rassweiler was graduated from the University of Denver in 1920. He secured his Master's degree from the University of Illinois in 1922, and his Ph.D. from the same institution in 1924. He joined the duPont organization in 1924 as a research chemist and since 1932 he has been director of the duPont Laboratory in Philadelphia, one of three laboratories of this company operated under the direction of Dr. John Marshall.

McQuay, Inc., Minneapolis, has appointed *O. H. Halberg* as its representative for New York City, Brooklyn, Staten Island, and Long Island areas. Mr. Halberg was for eleven years representative for The Trane Company in the New York City territory. Prior to that time he was associated with the A. F. Hinricksen, Inc., and Warren Webster & Company.

York Oil Burner Co., York, Pa., has appointed *Ray Babcock* as representative for New York and northern New Jersey. *George Frank* has been appointed manager of the Rotary Division.

NEW TRADE LITERATURE

Air Diffusers. A standard size, 24-page catalog on Air Devices type R Temperature Equalizers. Catalog is designed to serve as a handbook for engineers specifying and installing type R Agitair diffusers. Gives information on method of installation, how to specify, air capacities and similar details of interest to air conditioning and heating engineers. Air Devices, Inc., 17 East 42nd Street, New York, N. Y.

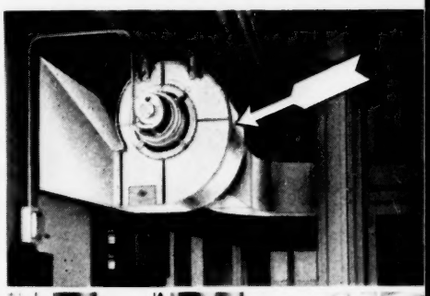
Filters. A 44-page catalog illustrating and completely describing the latest Staynew and Protectomotor filters for compressed air, gases, liquids, engine and compressor intake, and for building ventilation. The catalog is replete with photographic illustrations, sectional drawings, diagrams, specification charts, and detailed engineering data. The catalog is available to persons requesting it on business letterhead. Staynew Filter Corporation, Rochester, N. Y.

Fans. A four-page standard size catalog No. 165 entitled, "Viking Circoolator Ventilating Fans for Commercial Use." Gives information on the features, specifications, and dimensions of Viking exhaust fans, roof ventilators, and automatic outside shutters. Viking Air Conditioning Corp., 9500 Richmond Ave., S.E., Cleveland, Ohio.

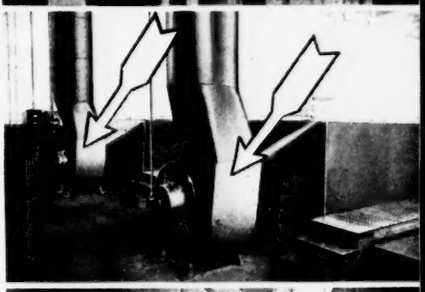
Heat Transfer Surface. Four-page standard size mailing piece on Nesbitt heating and cooling surfaces. Gives information on the Nesbitt series W surface for cooling, dehumidifying, and heating and tells how surface is protected against freezing. John J. Nesbitt, Inc., Holmesburg, Philadelphia, Pa.

Heating Equipment. Standard size, 63-page catalog covering the complete 1941 line of the products of the National Radiator Company. Gives complete specifications, features of construction, and installation information. The National Radiator Company, Johnstown, Pa.

MOUNT 'EM ANYWHERE...
On Floor, Wall or Ceiling!

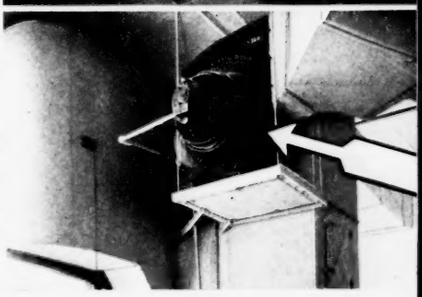


No apparatus you install is more *flexible* than ILG Direct-Connected Blowers! For you can mount 'em anywhere—on floor, wall, or ceiling—use one of 64 discharge arrangements—have motor on either side and change from right to left drive with any discharge!



Direct-Connection Solves Location Problems, Too!

Since recessed motor is direct-connected to blower wheel with a short motor shaft, overall space required for entire unit is little more than that needed by the blower alone. Think what that means when you bump into a tight corner placement!



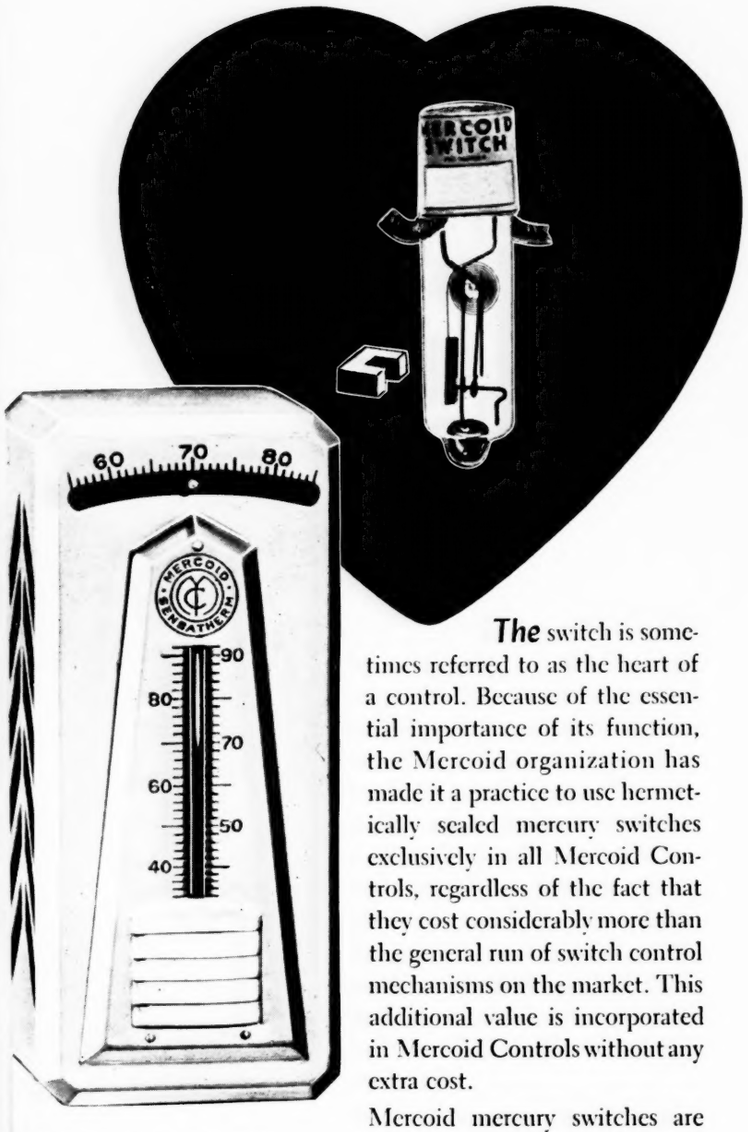
To get this whole story . . . and description of ILG's other outstanding mechanical superiorities . . . send for Catalog EB-381 today!

ILG ELECTRIC VENTILATING CO.
2858 N. CRAWFORD AVENUE, CHICAGO, ILL.
Offices in 43 Principal Cities

ILG

*Vitalized** **VENTILATION**
AND AIR CONDITIONING
**AIR CHANGE...NOT JUST AIR MOVEMENT!*

IT'S THE MERCURY SWITCH THAT DISTINGUISHES *Mercoid* FROM THE AVERAGE LINE OF CONTROLS



The switch is sometimes referred to as the heart of a control. Because of the essential importance of its function, the Mercoid organization has made it a practice to use hermetically sealed mercury switches exclusively in all Mercoid Controls, regardless of the fact that they cost considerably more than the general run of switch control mechanisms on the market. This additional value is incorporated in Mercoid Controls without any extra cost.

Mercoid mercury switches are not affected by dust, dirt or corrosion, a common source of trouble. They are also known for their long life, operating indefinitely without showing any indication of deterioration.

The Mercoid Sensatherm and the magnetic type mercury switch used in this thermostat are shown above. The tube remains in a stationary position and the magnet is moved to and from the side of the switch by the bimetal coil as it is actuated by temperature changes. One electrode remains in a fixed position in the small pool of mercury at the bottom of the tube. The movable electrode is attached to the armature which is actuated by the magnetic lines of force from the magnet to either open or close the circuit.

Some Sensatherms have been in continuous service since 1931 when they were first put on the market and are operating today with the same precision as the day they were installed.

The Mercoid Sensatherm is small in size, neat in appearance, and is steadily increasing in popularity.

Use Mercoid Controls—it is the sure path to customer satisfaction.

Write for booklet
"What You Should Know About Automatic Controls."

THE MERCOID CORPORATION • 4205 BELMONT AVE. • CHICAGO, ILL.

Hot Water. A pocket-size 28-page catalog C99 which covers the entire line of Taco equipment. Includes descriptions, specifications, and installation information on Taco service water heating equipment and Taco hot water heating systems. Also included is a list of all the Taco sales aids which are available for contractors. TACO HEATERS, INC., 342 Madison Avenue, New York.

Instruments. A standard size 32-page catalog 699E which lists and describes more than 100 different types of oil testing instruments. In addition to a complete listing of ASTM thermometers and API hydrometers, the entire TAG line of miscellaneous and general testing thermometers and hydrometers is featured. C. J. TAGLIABUE MFG. CO., Park and Nostrand Ave., New York.

Motors. Three-standard size loose-leaf sheets on Century explosion proof motors. The first sheet No. X167 discusses why the Century explosion proof motors have the Underwriters' label and tells what the different classes of labels mean. The second sheet, No. X164, illustrates the Century explosion proof—Class 1, Group D motor which is used in locations where the surrounding atmosphere is charged with such contaminants as gasoline, natural gas, alcohol, or other vapors. The third sheet, X160, illustrates the explosion proof motor—Class 2, Group G which is designed for installations where the atmosphere is carrying quantities of grain dust. CENTURY ELECTRIC COMPANY, St. Louis, Mo.

Motorized Valves. A standard size, 24-page catalog No. 77-1 entitled "Brown and Minneapolis-Honeywell Industrial Power Units and Motorized Valves." Catalog describes a line of power units and motorized valves designed to operate with Brown control instruments. THE BROWN INSTRUMENT COMPANY, DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY, Philadelphia, Pa.

Recording Charts. A 4-page standard size folder on the Permochart Vinylite plastic chart, which is a recording instrument chart designed for continuous reuse. Folder contains information on chart construction details, installation and prices. A sample Permochart is enclosed to illustrate how the daily ink record can be easily removed from the chart. PERMOCHART COMPANY, 425 Chestnut Road, Edgeworth, Sewickley, Pa.

Repair Cement. A 40-page pocket size Smooth-On handbook giving details on how to make low-cost repairs to equipment and pipe lines without dismantling or use of heat. There are 170 diagrams and instructions on sealing cracks in castings, stopping leaks in apparatus, tightening loose fixtures, making tight joints and similar repairs. SMOOTH-ON MFG. CO., Dept. 164, 570 Communipaw Ave., Jersey City, N. J.

Safety Devices. A 6-page standard size, loose-leaf condensed catalog and price list of McDonnell & Miller safety devices for steam, hot water and warm air heating plants. Includes brief information on boiler water feeders and low water cut-offs, the No. 29 snap action safety valve for hot water heating boilers and the McDonnell humidifier water level control for warm air furnaces. MCDONNELL & MILLER, 1306 Wrigley Building, Chicago, Ill.

Controls. A catalog of controls for heating and cooling equipment. Catalog is designed to enable the prospective purchaser to locate quickly and easily complete prices, and information on the type of control needed. SAMPSEL TIME CONTROL, INC., Spring Valley, Ill.

Fans. A 16-page, standard size catalog, X4059 which illustrates and describes exhaust and ventilating fans for commercial, industrial, and domestic installations. Includes information on where and how to install exhaust and ventilating fans for maximum benefits and how to determine the most effective sizes of fan to use. Also gives dimensions, performance and prices for all Emerson fans. THE EMERSON ELECTRIC MFG. COMPANY, St. Louis, Mo.

Valves. A 32-page booklet entitled "Where to Use Valve Drains—By-Passes." Purpose of this booklet is to give simple, brief facts about the characteristics of each basic valve type, the extent of flow it permits, the available variations of patterns and parts and the particular classes and kinds of service for which that type of valve is recommended. Included is a list of all Jenkins valves meeting the ASME Power Boiler Code. JENKINS BROS., 80 White Street, New York, N. Y.

Corrosion. A four-page bulletin entitled, "What to Do About Water Pipe Corrosion." Bulletin describes the cause of pipe corrosion and the effect of corrosive waters on iron and brass pipes. Also discusses methods of overcoming and preventing rusty water, diminished flow, leaks and breaks. WATER SERVICE LABORATORIES, INC., 423 WEST 126TH ST., NEW YORK, N. Y.

Unit Heaters. A 24-page standard size bulletin 46E-10 on Carrier unit heaters. Includes rating tables for steam and hot water unit heaters, pipe and wiring diagrams and typical building lay-outs showing location of unit heaters. CARRIER CORP., SYRACUSE, N. Y.

COMING EVENTS

JUNE 16-20, 1941. The Pacific Heating and Air Conditioning Exposition, Exposition Auditorium, San Francisco, Cal. Managed by the International Exposition Company, Grand Central Palace, New York.

JUNE 16-20, 1941. Meeting of the Heating, Piping and Air Conditioning National Association. To be held at St. Francis Hotel, San Francisco, Cal.

JUNE 16-20, 1941. Summer Meeting of the American Society of Heating and Ventilating Engineers. To be held at Palace Hotel, San Francisco, Cal.

JUNE 19-20—First Annual New England Conference on Anthracite Utilization at Massachusetts Institute of Technology, Boston, Massachusetts, under sponsorship of the Commonwealth of Massachusetts University Extension.

JUNE 23-27, 1941. Annual meeting and exhibit of the American Society for Testing Materials. Palmer House, Chicago, Ill. For information, write Society at 260 So. Broad St., Philadelphia, Pa.

OCTOBER 14-17. 70th annual meeting of the American Public Health Association to be held at Convention Hall, Atlantic City, N. J. Headquarters, Hotel Traymore. For information, write to American Public Health Association, 1790 Broadway, New York, N. Y.

H&V'S PHOTOS

Page 24-26—American Gas Association, N. Y.
Page 33—Fairchild Aerial Surveys, Inc., N. Y.
Page 44-45—H. W. Porter & Co., Inc., Newark, N. J.
Page 48—(Upper left) Ric-wiL Co., Cleveland, and all others, Tube-Turns, Inc., Louisville, Ky.
Page 49-50—Ric-wiL Co., Cleveland, Ohio.
Page 51—The Moss-Chase Co., Buffalo, N. Y.

ALCO Multi-Outlet Thermo Valves

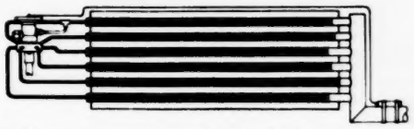
Offer BETTER DISTRIBUTION and Insure FULL COIL CAPACITY

Use ALL the Coil Surface You Buy!

HAVE you ever installed a larger coil to get capacity when the original coil had plenty of surface? Chances are the trouble was poor distribution. If refrigerant had been distributed evenly to every circuit, the original coil would have had plenty of capacity.

Many jobs are in operation on which the refrigerant is short circuiting through a few circuits and is affecting the thermo valve bulb so that the valve remains choked off. This means that often as little as 50 per cent of some of the circuits are doing any real work.

Alco Multi-outlet valves increase coil capacity as much as 25 per cent because they provide better distribution of refrigerant than is possible with ordinary distributors.

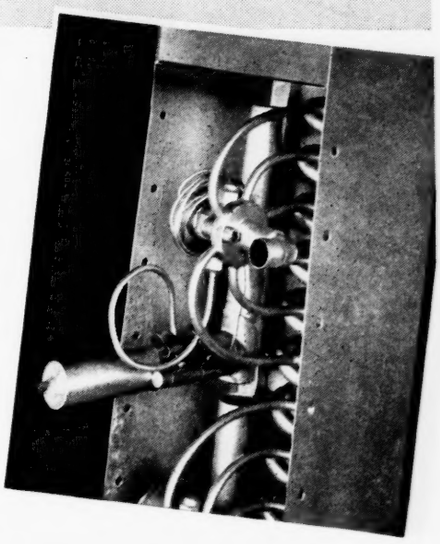


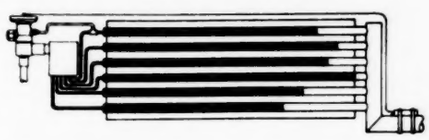
Refrigerant distribution with Alco Multi-outlet thermo valve. Note refrigerant is distributed equally and entire surface is utilized.

Distribution takes place within the valve body, at the point of expansion and before separation of gas and liquid occurs.

With Alco Multi-outlet thermo valves the feed to each circuit is equal and direct and distribution is not affected by load changes.

To get what you pay for—be sure that all of your coil surface is working—specify Alco Multi-outlet valves.





Refrigerant distribution with conventional distributor header and single outlet thermo valve. Note wide variation in refrigerant distribution and wasted coil surface.

Engineered Refrigerant Controls

THE STANDARD OF THE INDUSTRY

ALCO VALVE CO.

2624 Big Bend Blvd. St. Louis, Missouri

New York • Chicago
Los Angeles • Seattle
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YARWAY GUN-PAKT EXPANSION JOINT

It is packed under full steam pressure. By the turn of a wrench, integral pressure guns force a special semi-plastic packing into the stuffing box.

Welded Steel Construction. Alemite lubricated cylinder-guided sleeve. Made also in conventional gland-pakt types. Write for Bulletin EJ-1907.

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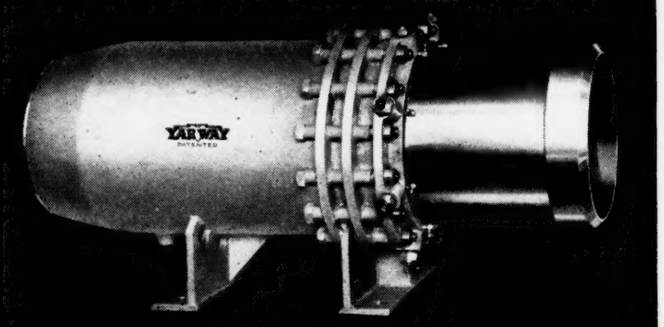
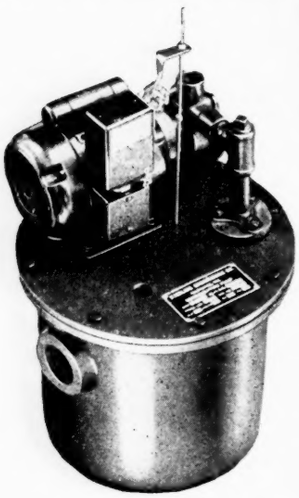
YARNALL-WARING COMPANY
104 Mermaid Ave. PHILADELPHIA



STERLING "LOWBOY" CONDENSATION PUMP COSTS LESS THAN PITTING THE BOILER!



"Low-Boy" in Cost, "Hi-Boy" in Performance, the Sterling 4000 above ground or underground Condensation Pump avoids boiler pitting, costs less than installation of a boiler return trap. Economical, efficient. Made with Cast Iron, lifetime receiver, close-coupled centrifugal turbine type bronze impeller and wearing rings, stainless steel shaft, packless-dripless rotary shaft seal. Uses only a 1/6 H.P. motor. Heavy-duty float switch, copper float.

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3732F N. Holton St., MILWAUKEE, WIS.

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WE CAN SHIP SOONER

SHELL AND TUBE CONDENSERS
BRINE COOLERS
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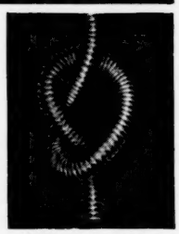
ACME INDUSTRIES, INC.
JACKSON, MICHIGAN

ECLIPSE SEAMLESS FLEXIBLE METAL HOSE

Of seamless, all metal, parallel corrugated, armored construction, in various alloys with renewable type fittings approved for the conveyance of non-solids and non-abrasives in *Aviation, Automotive, Marine, Heating, Air Conditioning, Mining, Power Generation, Plastic and Textile applications* wherein conditions of flexing and expansion between delivering and receiving connections exist. Also available for shielding and exhaust applications.



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METAL HOSE DEPARTMENT
ECLIPSE AVIATION, BENDIX, N. J.
Division of Bendix Aviation Corporation

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FOR ACCURATE TEMPERATURE CONTROL

The powerful, uniform expansion and contraction of a solid-liquid charge against a stainless steel diaphragm, plus the mechanical simplicity of White-Rodgers Controls assures *accurate performance, easy adjustment and trouble-free operation.* It will pay you to send today for the new White-Rodgers Condensed Catalog!

Type 519 Combination Fan and Limit Control. Range 100° to 300° Fahrenheit.

WHITE-RODGERS ELECTRIC CO.
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For checking heating plant operation and predicting fuel consumption. $3.

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THE INDUSTRIAL PRESS, 148 Lafayette St., New York

HEATING AND VENTILATING

The Air Conditioning Monthly